

# Debt, Deficits and Fiscal Policy in Portugal

*An econometric analysis*

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II

# Abstract

Fiscal policy in Portugal has been on an unsustainable path since 2004, at least. An econometric analysis, taking into account Portugal's economic history, applied to an annual dataset from 1977 until 2011 illustrates a positive response in fiscal policy to increased debt. However, the response is not sufficient to stabilise the current debt-to-GDP level.



# Preface

With the completion of this thesis my time as a student at the department of economics at the University of Oslo comes to an end, and I would like to thank my fellow students for providing many happy moments throughout these two challenging academic years.

This thesis would not have been possible without the assistance of my supervisor, Ragnar Nymoen, professor at the University of Oslo. I am grateful for his helpful advice, and valuable suggestions and comments throughout the process in addition to the time he devoted.

I would like to thank Ola Thorseth who has been my mental rock the past five months. He has helped me ask reflective questions along the way, and I am thankful for his valuable and constructive feedback. I am grateful for the effort Oisín Zimmerman, Amalie Stang, Kirsten Viga Skretting, Maren Husby and Karina Tytlandsvik have put in as proof readers, and the final comments provided by the trainees at Nordic Securities, Samir Khorram and Vilde Ahlstrøm.

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Needless to say, all remaining mistakes are my own.



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# 1 Introduction

The main research topic for macroeconomic policies has been monetary policy, and fiscal policy has been, by some, neglected. Monetary policy has been seen as the only tool to provide inflation stability. In light of the current fiscal crises in the Euro-zone fiscal policy has become a more relevant and debated issue. Fiscal policy as a tool to correct for asymmetric shocks within a monetary union has been brought into discussions about the future of the Euro-zone. (Favero & Monacelli, 2005).

This thesis will investigate Portugal's fiscal position and test if it exists an adjustment in fiscal policy when public debt increases. This can be considered as a test for sustainability of public finances.

First, I will provide an outline of Portugal's economic history. Second, motivate the importance of a sound fiscal policy, and provide a brief theoretical model and a review of existing literature. At last, an econometric analysis mounted on Claeys (2008) will be used.

## 2 History of the Portuguese economy

### 2.1 Salazar regime

Antonio Salazar led Portugal, undisrupted, as a fascist dictatorship from 1932 until his death in 1968. Salazar started as a Minister of Finance in Portugal in 1928, and gradually seized more power, until he was Prime Minister in 1932. Salazar was determined to stabilize the Portuguese economy, i.e. balance the budgets, reduce debt and stabilise the currency “the Escudo”. Salazar was a professor of Economics from the University of Coimbra. (Corkill, 1993, pp. 1-4).

Portugal was in the first half of the 20<sup>th</sup> century the poorest country in Europe, and a colonial power. Salazar’s regime shifted its policies in the 1960’s. Pre 1960, the institutional framework became known as “Estado Novo”<sup>1</sup> which compromised the Colonial act in 1930, the new Constitution (1933) and the Labour Statute (1933). The regime was broadly an autarky based on self-sufficiency and limited influence and reliance from external countries. (Corkill, 1999, p. 11).

Portuguese economic policy changed in the 1960’s. The change started with membership in the European Free Trade Association, where Portugal was one of the founding member states in 1958, and in 1960 membership in the International Monetary Fund, henceforth IMF, the General Agreement on Tariffs and Trade, and the World Bank. This was a reorientation in trade policies from protectionism and autarky towards the international markets, especially the European. (Corkill, 1993, pp. 1-4).

The motivation for the change in policies was mainly due to finance the colonial wars (Corkill, 1993, pp. 19-20).

Salazar was succeeded by Marcelo Caetano in 1968, who lead Portugal until the revolution in 1974. Caetano acknowledged that “the economic autarkism had long since outlived its usefulness” and Portugal had to take advantage of the expanding world economy and restructure industry in order to gain competitiveness. (Corkill, 1993, p. 29).

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<sup>1</sup> English: New Stage

Table 1: Portugal and Europe: The Timetable

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1957	Six countries sign the treaty of Rome establishing the European Economic Community
1960	Portugal is a founder member of the European Free Trade Association, EFTA.
1972	Agreement between Portugal and the EC improving trade relations and other contacts.
1974	European Regional Development Fund (FEDER) set up.
1977	Portugal formally requests entry into EEC (March).
1978	Creation of European Monetary System (EMS). Council of Ministers accepts the principle of enlargement (April). Official opening of negotiations with Portugal.
1981	European Monetary Unit (Ecu) first appears.
1985	Completion of EC enlargement negotiations (March).
1986	Formal entry into Community of Portugal and Spain.
1987	Single European Act (SEA) signed.
1988	Structural Funds doubled (February).
1991	EEC and EFTA agree to set up a European Economic Area (EEA) in 1993.
1993	Inauguration of single market (January).
1994	Economic and Monetary Union (Stage two); member states move to narrow band of ERM (January).
1996	Full integration of Portugal into the Community structure as “a member with full rights and duties”.
1999	Introduction of single currency.

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Source: Corkill (1993, p. 90)

## 2.2 1974: Revolution

On 25 April 1974 a coup d'état was led by the Armed Forces Movement, and the provisional government that followed was dominated by the Portuguese Communist Party. The new government started a “transition into socialism”. They dissolved former monopolies and nationalised basic industries, and the size of the public sector doubled during the first 2 years after the revolution. (Corkill, 1993, p. 37).

Although the revolution itself was peaceful it can be considered as a negative economic shock. For Portugal the revolution led one of the largest public sectors in Western Europe, a

drain in human capital as a result of an anti-fascist purge campaign, and a diminished market for trade after decolonisation, and an influx of refugees. (Corkill, 1993, pp. 38-39).

In addition it was mainly the larger, and productive, industries that were nationalised, but these had to absorb all superfluous labour together with the public sector. In addition, Portugal seemed ill prepared to handle the demands for higher wages from labour unions. (Corkill, 1993, pp. 35, 38-39). The wage increase in Portugal can be illustrated through the increase in unit labour costs which is an indicator of declining competitiveness.

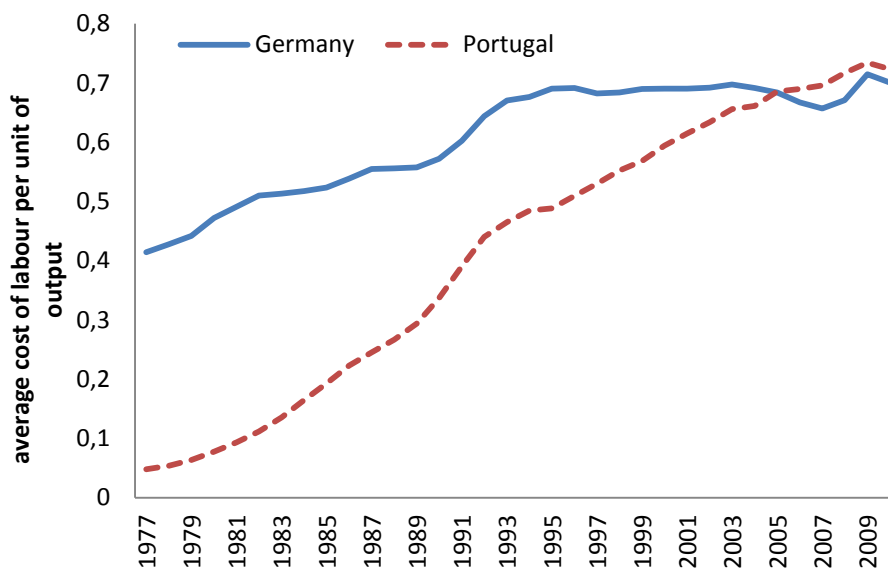


Figure 1: Unit labour costs in Portugal and Germany.

Figure 1 demonstrates the unit labour costs in Portugal (broken line) and Germany (solid line)<sup>2</sup>. The OECD defines unit labour costs as “measure the average cost of labour per unit of output. They are calculated as the ratio of total labour costs to real output. As such, a ULC represents a link between productivity and the cost of labour in producing output”. The OECD ensures that data are comparable across countries. (OECD, 2007). Compared to Germany, Portugal has had a large increase in unit labour costs, and is now at the same level as Germany.

The major feature of the Portuguese post-revolution economy is that it had one of the fastest rates of growth in long-term debt in the world. After austerity measures failed to reduce the increasing current account deficit and debt the IMF had to dictate monetary policy during 1977-79. The IMF pinpointed three causes of the crisis: wage inflation, an overvalued

<sup>2</sup> Data from the OECD statistical database.

currency, and a lax monetary policy. The IMF “cure” consists of export stimulation through devaluation, lower wages, austerity, increased interest rates and stricter credit controls. The cure was a short-term success, inflation fell and the current account deficit was reduced. The IMF was not the sole reason for the recovery, a major factor contributing to the decreased current account surplus was the economic upturn facing the US and Europe. This increased the demand for Portugal’s exports, combined with increased tourism and remittances from emigrants. (Corkill, 1993, pp. 40-50).

Due to the rapid recovery Portugal did not have to go through necessary structural changes to combat the bad economic state they were in. So with a change of government in 1980, the constitution was changed and the phrases “the transition to socialism” and “the construction of a socialist economy” was deleted, but Portugal continued to finance expansion with foreign borrowing. Exports could not keep up, and another equivalent “cure” by the IMF was initiated in 1983-1984. (Corkill, 1993, pp. 50-51).

Corkill (1999, p. 69) describes the period from 1975 to 1985 a “lost decade” as far as economic modernisation is concerned.

## **2.3 1986: EU membership**

Portugal was, along with Spain, allowed into the European Community (predecessor to the European Union, henceforth EU) formally in 1986. The Portuguese economy was still characterised by protectionist policies, and the Portuguese feared that their industry would not survive in an open market with a competitive structure. The manufacturing sector was more positive to the membership, as they had a low wage level compared to the rest of Western Europe and could predict an increase in export shares. The EU membership would also give incentives to investment through falling interest rates. (Corkill, 1993, pp. 90-93).

Along with the EC membership a stable political period followed with the first ever single-party majority government in 1987. Prime Minister Cavaco Silva lead Portugal as head of the social democratic party, from 1985-1995. The Cavaco Silva period is characterised by more liberal policies which included pro-free enterprise, a pro-business stance and the government committed themselves to privatise a substantial proportion of the state enterprise sector. The political stability combined with favourable exogenous factors (falling oil and raw material

prices, declining interest rates, an upturn in European growth and the arrival of pre-accession aid from Brussels) gave room for economic growth. (Corkill, 1993, p. 118; 1999, p. 69)

The reforms introduced by Cavaco Silva helped create the conditions for growth. Inflation was tamed, the financial system liberalised, the presence and weight of the state in the economy was reduced, flexibility into the labour laws was introduced, and private capital reached new areas. (Corkill, 1999, p. 214).

One of the major reforms introduced by Cavaco Silva was privatisation of the nationalised firms. After the revolution the constitution had prohibited sale of state enterprises, and the government should be majority owners of all state enterprises. The constitution was changed in 1989 and 1990, so that repurchasing of the privatised firms were not allowed and the government was allowed to sell off more than the 49% previously allowed. The revenue from privatisation was used to service the cost of public debt and restructure the state enterprise sector. The main goal for the privatisation process was to reduce the burden of poorly performing state-owned enterprises, to modernise and increase competitiveness of Portuguese firms and attract foreign direct investments. (Corkill, 1999, pp. 56-57).

The economic policies conducted in Portugal in the 1990's can be seen as a preparation for joining the European Monetary Union (EMU) in 1997 (Corkill, 1999, pp. 228-230).

Portugal's currency, the Escudo, joined the exchange rate mechanism (ERM) of the European Monetary System (EMS) in April 1992, and the main goal was to bring inflation down and closer to the other countries level to achieve price stability. The Escudo was allowed to trade within the wider band, and fluctuate six per cent on either side of the central rate<sup>3</sup>. (Abreu, 2001, pp. 17-20).

In order to meet the Maastricht Criteria sketched in Box 1 Portugal had to stabilise its government debt, budget deficit, and further reduce inflation while keeping the exchange rate stable and interest rates low without spoiling growth opportunities. (Corkill, 1999, pp. 230-231).

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<sup>3</sup> The ECU central rate was set at about 1,4% below the market rate prevailing at the time. (Abreu, 2001, p. 24)

Box 1: The Maastricht criteria. Source Corkill (1999, p. 230)

- Inflation had to be not more than 1,5% above the average of the three best performing economies.
- The budget deficit had to remain under a 3% of gross domestic product, henceforth GDP, ceiling.
- Public debt must be at or below 60% GDP. Alternatively a country must demonstrate that it is making significant progress to this end.
- Long-term interest rates had to be no more than 2% above the average achieved by the three best performers.
- The exchange rate had to remain within the narrow band of the ERM for two years (Portugal's good recent record on currency stability, far superior to Spain and Italy, was particularly helpful in this regard)

Portugal was below the requirement of public debt already in 1992 at a debt level of 49,9%<sup>4</sup>. They managed to barely stay below the target; the debt increased but due to falling interest rates, hence reduced debt servicing costs, privatisation receipts and more efficient tax collection they managed to stay below the 60% of GDP limit. (Corkill, 1999, p. 232).

In 1992 Portugal had a record high budget surplus at 3,6%. The budget surplus deteriorated until accession, fluctuating at around 0% of GDP. Portugal managed to stay within the target of no more than 3% deficit mainly due to lowered interest rates on their debt, however both the primary balance and the cyclically-adjusted primary balance as a per cent of GDP deteriorated from 1995-1998. (Abreu, 2001, p. 27). In addition, reductions in public expenditures and more efficient tax collection contributed in lowering the deficit to GDP ratio (Corkill, 1999, p. 232).

The Portuguese economy experienced high rates of inflation compared to the other EC members. In 1992 inflation was at 9,44% which was much higher than the three best performing countries. Portugal managed to bring inflation down to 2,31% in 1997 a level consistent with price stability and up to par with the best performing countries. Banco de Portugal managed to conduct such a policy to make inflation expectations credible. Deceleration of wages, non-tradable goods prices and unit labour costs due to the negative output gap in 1993 made Portugal comply with the price stability criteria of the Maastricht treaty in July 1997. (Abreu, 2001, pp. 18-20).

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<sup>4</sup> The figures referred to in this the text are consistent with the one's I use in my econometric analysis from Bank of Portugal's statistical database and AMECO, but not with Corkill's figures.

Nominal interest rates were lowered during the 1990s due to stability of the nominal exchange rate and reduced inflation. Nominal convergence and the prospect of EMU participation is described as a virtuous circle: “Progress towards nominal convergence increased the likelihood of Portugal meeting convergence criteria for EMU participation, whereas at the same time, increased prospects of EMU participation facilitated exchange rate stability, the convergence of interest rates to the lowest levels in the EU and the improvement of the budget balance”. (Abreu, 2001, p. 27).

This resulted in Portugal adopting the Euro in 1999. (Afonso, Claeys, & Sousa, 2011, p. 84)

## 2.4 Portugal after the EURO

After Portugal adopted the Euro in 1999, it was the first country to break the Maastricht Criteria’s Stability and Growth Pact’s 3% deficit requirement in the 3<sup>rd</sup> quarter of 2002 and they became subject to the excessive deficit procedure (EDP) and again in 2005 and 2009. (Afonso, et al., 2011, p. 84).

"The Economic Adjustment Programme for Portugal" 2011) is a report by the European commission requested by Portugal on 7 April 2011. It describes a program where the goals are to “*underpin economic growth and macro-financial stability and to restore financial market confidence*” ("The Economic Adjustment Programme for Portugal," 2011, p. 16) and it covers the period 2011-2014. The three main points are:

- i) *Putting fiscal policy on a sustainable footing*. The debt to GDP ratio should be on a downward path from 2013. It focuses on expenditure reducing measures, making the public sector more lenient and efficient.
- ii) *Stabilisation of the financial sector*. Strengthen bank’s liquidity and solvency through higher capital adequacy ratios and a solvency support fund.
- iii) *In-depth structural reforms* to restore external and internal balances and to raise potential growth. This entails reform of the labour market, reinforcement of competitiveness, a review of the judicial system, housing and rental market reform, liberalisations in services sector and network industries, reducing the administrative burden on companies, scaling down the direct involvement of government in the economy, strengthening human capital via further reform of the education system.

("The Economic Adjustment Programme for Portugal," 2011, p. 16)



A decade of low productivity growth, deteriorating competitiveness and growing indebtedness has made the “The Economic Adjustment Programme for Portugal” necessary. During the period before the financial crisis (2001-08), the average annual real GDP growth of the Portuguese economy was 1%, the second lowest in EU-27. (“The Economic Adjustment Programme for Portugal,” 2011, p. 5).

Portugal’s public finances have deteriorated since the country joined the euro area. Government deficit has been above the 3% limit almost every year. Economic growth has plummeted, expenditure growth has increased and the debt-to-GDP has, as a result, increased from about 60% in 2004 to a projected 100% in 2011. (“The Economic Adjustment Programme for Portugal,” 2011, p. 9).

The global financial crises in 2008 did not harm the Portuguese economy directly because it was not exposed to the toxic assets. The property “boom and bust” that were present in many countries were absent in Portugal. (“The Economic Adjustment Programme for Portugal,” 2011, p. 8).

At the time of writing, the Portuguese government has embarked on an ambitious path towards macroeconomic stability. The global crises revealed Portugal’s weak fiscal position, with public debt at around 90% of GDP and private sector debt at around 260% of GDP and as a result banks with the highest loan-to-deposit ratio in Europe. The goal is that public deficit shall be at 3% of GDP in 2013 according to the EDP, and then the public debt will stabilise. (“The Economic Adjustment Programme for Portugal,” 2011, p. 41).

### **3 Existing literature and the importance of fiscal discipline**

The on-going public debt crisis in the Euro area is a result of the global financial crisis that started in 2007 and which hit Europe with full force in the autumn of 2008 with the collapse of Lehman Brothers. The period between 2001 and 2007 is characterised as a period of “unprecedented prosperity, the combination of sustained growth and declining inflation”.

The global financial crises in 2007 was a result of deregulation of financial markets both in the U.S, with the final abolishment of the Glass-Steagall act<sup>5</sup> from 1933 in 1999, and in Europe with the “Single European act” in 1986.

Subprime mortgages were not allowed in the European Union, at least not in the same manner as they were in the U.S. However, European banks were exposed to the subprime mortgages in the U.S. and a lot of European banks also went into distress because of liquidity and/or solvency problems. The main trigger for the public debt crises in the Eurozone were the lesson from the “Great depression”. In order to avoid a recession, European governments should conduct expansionary fiscal policy and bail-out their banks and other financial institutions.

Regarding Portugal, their banks where not heavily exposed to the toxic assets and did not undergo a banking crisis, but they did conduct expansionary fiscal policy that has led to their high debt levels, as was illustrated in section 2.4. This massive debt build-up led financial markets to doubt whether public finances in European countries, especially Portugal, Ireland, Italy, Greece and Spain were sustainable. This led to increased interest rates for sovereign bonds, and increased debt servicing costs for the involved countries, making their debt obligations even harder to fulfil. (Baldwin & Wyplosz, 2012, pp. 524-533).

#### **3.1 Debt and economic growth**

Reinhart and Rogoff (2009, p. 471) find that the historical average increase in real government debt after a financial crisis is 86%. This has been a characteristic of the aftermath

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<sup>5</sup> Glass-Steagall Act of 1933: separated investment banks from traditional “savings & loans” as a response to the stock market crash in 1929, and the following “great depression”.

of banking crisis for the past century. Reinhart and Rogoff use the increase in debt rather than the debt-to-GDP ratio, because GDP may also be affected by the banking crisis. They found that the debt increase owed to a reduction in tax revenue and countercyclical fiscal policy aimed at mitigating the downturn.

Reinhart and Rogoff (2010, pp. 575-578) study the connection between real economic growth<sup>6</sup> and different debt-to-GDP levels for 20 advanced economies<sup>7</sup> in the period 1790-2009. They find a clear pattern between high debt-to-GDP ratios and low growth rates. When the debt-to-GDP rate exceeds 90%, average real growth rate is 1,7% compared to approximately 3% for debt-to-GDP levels lower than 90%. They have included data for Portugal, and the recorded real growth rates are 4,8% for debt-to-GDP levels of below 30%, 2,5% for debt-to-GDP levels between 30 and 60%, 1,4% for debt levels between 60 and 90%. Reinhart and Rogoff have not commented on the debt levels above 90% of GDP, as their data series ended in 2009. But the picture is clear: when the debt-to-GDP ratio becomes too large, it is associated with low economic growth.

Governments can affect stability of the economy and its growth rate through their debt policies. A government who runs a balanced budget has a higher growth rate in the long-run than an economy that runs continuous budget deficits. The economic reason is that budget deficits lead to crowding out of investments, and in return the share of consumption-to-GDP is larger than the share of investments-to-GDP. This leads to a lower balanced growth rate in the long-run than under a balanced budget where there is no crowding out of investment.

Greiner and Fincke (2009, pp. 71-79)

Greiner and Fincke's model can be extended to include a productive government sector that can run deficits to finance public investment. They assume that fiscal policy is so that the debt-to-GDP ratio remains sustainable. They further find that a "balanced budget scenario" results in a higher long-run growth rate. The alternative scenario is where public debt grows at a balanced growth rate along with the rest of the economy, as it will without a productive public sector. A debt financed productive public investments "raises the transitional growth rates but leads to a smaller long-run growth rate if this fiscal policy leads to a positive debt

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<sup>6</sup> Reinhart and Rogoff do not define growth in a specific manner in neither of the articles cited in this paper, nor in their book "This time is different, eight centuries of financial folly" published by Princeton University Press in 2009.

<sup>7</sup> Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, The United Kingdom, and the United States.

ratio in the long-run. Only if the government switches back to the balanced budget scenario or to the scenario where public debt grows slower than capital and output, a temporarily deficit financed public investment raises transition growth without leading to smaller growth in the long-run". (Greiner & Fincke, 2009, pp. 83-108).

In conclusion loose fiscal policy, where governments do not pay great attention to stabilising debt at a low level compared to GDP, do not promote sustained growth in the long-run, unless the government is a creditor.

## **3.2 A small model for sustainable debt**

### **3.2.1 Wealth dynamics - the connection between debt and deficits.**

Rødseth (2000, pp. 113-164) presents a model for the extremely open economy, and explains the relationship between wealth, debt and deficits in a pedagogical and precise manner. This section will follow Rødseth's exposition closely for explaining government and foreign wealth dynamics in a growing economy in order to provide the main theoretical reference for wealth dynamics.

Rødseth assume fully flexible wages, full purchasing power parity<sup>8</sup> and a Hicksean income definition which is the maximum amount an economic agent can consume without reducing his real wealth and implies the use of real rates of return instead of nominal.

The model is set in a dynamic environment with economic growth. Along the balanced growth path, debt should grow at the same rate as output. This may lead to a situation with continuous current account and government deficits. Rødseth assume perfect capital mobility, that output is determined by supply, and that there are no real investments.

The model consists of three sectors, public, private and foreign, which are marked with the respective subscript g, p and \*. In order to shorten the presentation, the wealth dynamics of the private sector will be disregarded. There are three types of assets, money, domestic bonds and foreign currency. Foreigners are assumed to not hold assets denominated in domestic currency. Each sector holds its own portfolio.

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<sup>8</sup> Purchasing power parity implies the same price level at home and abroad.  $P=EP_*$

The private sector's portfolio becomes

$$(1) W_p = \frac{M + B + EF_p}{P},$$

with return equal to

$$(2) \rho_* W_p + r \frac{M + B}{P} - i \frac{M}{P},$$

where the last term is seignorage.

The government's portfolio becomes

$$(3) W_g = \frac{-M - B + EF_g}{P},$$

with a return equal to

$$(4) \rho_* W_g - r \frac{M + B}{P} + i \frac{M}{P}.$$

The equilibrium condition is

$$(5) W_p + W_g + W_* = 0.$$

In Rødseth's model the following notation apply:

- $\rho_*$  as the real interest rate
- $r$  as the risk premium  $r = i - i^* - e_e$
- $M$  as domestic money
- $B$  as domestic bonds
- $P$  as the domestic price level
- $T$  as taxes in real value
- $G$  as government consumption
- $C$  as private consumption
- $i$  as the nominal interest rate
- $F_i$  as foreign currency held by domestic sector  $i = p, g$  or  $*$
- $I$  as real investment undertaken by the private sector.

Real disposable income of the private and public sector are defined as

$$(6) \quad Y_p = Y + \rho_* W_p + r \frac{M+B}{P} - i \frac{M}{P} - T$$

$$(7) \quad Y_g = \rho_* W_g - r \frac{M+B}{P} + i \frac{M}{P} + T$$

and the national income is given as the sum of the two sectors real disposable incomes.

$$(8) \quad Y_p + Y_g = Y - \rho_* W_*$$

In equation (8)  $Y$  is the whole output, and  $\rho_* W_*$  is interest payments on foreign debt.

The growth in financial wealth in the three sectors are defined as

$$\begin{aligned} \dot{W}_p &= Y_p - C - I \\ (9) \quad \dot{W}_g &= Y_g - G \\ \dot{W}_* &= \rho_* W_* + C + G + I - Y \end{aligned}$$

Where  $(Y_p - C)$  and  $(Y_g - G)$  are considered private and public savings rates, so growth in financial wealth is considered the difference between savings and investments. From equation (9) it is clear why Rødseth use Hicks' definition of income; it renders it possible to write the change in financial wealth as the difference between savings and *real* investments, instead of nominal. The second line in equation (9) is the government surplus. The latter line of equation (9) is equal to the deficit on the current account.

The requirement for balanced growth is a path where the three sectors wealth-to-GDP ratios are constant. The wealth-to-GDP ratios are defined as

$$(10) \quad w_i = \frac{W_i}{Y} \quad \text{for } i=g, p \text{ or } *.$$

Differentiation of (10) yields

$$\begin{aligned}
(11) \quad & w_i \frac{d}{dt} = \frac{W_i}{Y} \frac{d}{dt} \text{ and using the formula for derivation of a fraction} \\
& \dot{w}_i = \frac{\dot{W}_i Y}{Y^2} - \frac{W_i \dot{Y}}{Y^2} \\
& \frac{\dot{Y}}{Y} = \gamma \text{ defines the growth rate of output} \\
& \dot{w}_i = \frac{\dot{W}_i - \gamma W_i}{Y}
\end{aligned}$$

The latter line of equation (11) is the growth rate of the wealth-to-GDP ratio for the three different sectors over time. The condition for balanced growth is  $\dot{w}_i = 0$ .

For the foreign sector this implies

$$(12) \quad \dot{w}_* = 0 \Rightarrow \dot{W}_* = \gamma W_*$$

the size of the permitted current account deficit,  $\dot{W}_*$ , is given as the growth rate of GDP times the existing foreign debt,  $\gamma W_*$ . A high growth rate therefore allows for higher deficits and continuous deficits in cases where there is continuous positive growth in output. On the other hand, if growth rates are low, perhaps negative, and the debt-to-GDP ratio is high, the permitted deficits are reduced, and perhaps even turned into required surpluses.

Stability of the government wealth ratio is derived from the growth of government financial wealth over time, and defined as

$$(13) \quad \dot{W}_g = \rho_* W_g + (\rho_* + p) \frac{M}{P} + T - G$$

And from the definition of the growth rate, equation (11), Rødseth finds that the growth of the public sector financial wealth over time is

$$(14) \quad \dot{w}_g = \frac{\dot{W}_g - \gamma W_g}{Y} = \frac{\rho_* W_g + (\rho_* + p) \frac{M}{P} + T - G - \gamma W_g}{Y}$$

He defines

$$m = \frac{M}{YP}$$

$$g = \frac{G}{Y}$$

And rewrite equation (14) as

$$(15) \quad \dot{w}_g = (\rho_* - \gamma)w_g + (\rho_* - p)m + \tau - g - \gamma w_g.$$

Government primary surplus,  $s$ , is defined as “the excess of seignorage and taxes over government expenditure on goods and services”. Measured relative to output the government’s primary surplus in equation (15) becomes

$$(16) \quad s = (\rho + p)m + \tau - g$$

The primary surplus can be used as an objective for fiscal policy, and keeping this constant is considered “constant fiscal policy”, as opposed to expansionary or contractive fiscal policy. Under constant fiscal policy the tax rate,  $\tau$ , government consumption relative to GDP,  $g$ , and inflation,  $m$ , is constant.

The stationary state of government debt is defined as  $\bar{w}_g$ . It is the level of debt that keeps the growth rate in government wealth equal to zero,  $\dot{w}_g = 0$ . Using the definition for the surplus, the stationary state becomes

$$(17) \quad \bar{w}_g = -\frac{s}{\rho_* - \gamma}.$$

Stability requires that the growth rate of GDP exceeds the real interest rate. The stability condition becomes

$$(18) \quad \frac{d\dot{w}_g}{dw_g} = \rho_* - \gamma < 0.$$

As long as the growth rate in GDP exceeds the real interest rate, the debt level will always end up in the stationary level  $\bar{w}_g$ , regardless of the initial level. On the other hand, if the real interest rate is higher than the growth rate of GDP the growth rate of government wealth is



unstable, and will eventually explode. In the unstable case, an initial wealth level above the stationary level will make wealth increase infinitely, and a level below the stationary level will lead to perpetual debt.

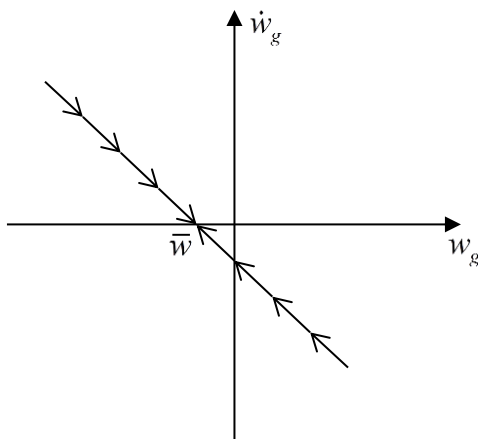
The primary surplus can be expressed as

$$(19) \quad s = -(\rho_* - \gamma) w_g .$$

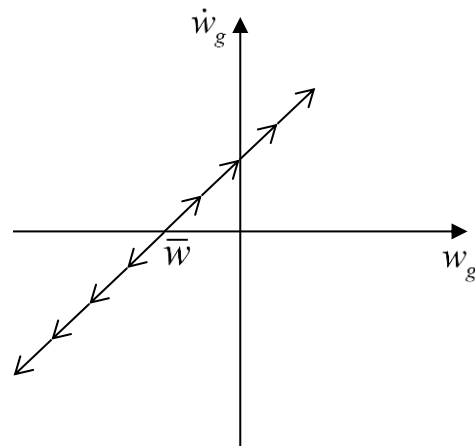
If the government has initial debt,  $w_g < 0$ , a positive primary surplus is required in order to prevent the public debt ratio from exploding. A simple theory for sustainable fiscal policy along the balanced growth path, where the objective is to prevent the public debt ratio from exploding, is that in the case of  $\rho_* < \gamma$ , any primary deficit,  $s$ , is sustainable. If instead,  $\rho_* > \gamma$  sustainability of fiscal policy requires that the surplus is larger than the debt servicing costs above the growth rate:

$$(20) \quad s \geq (\rho_* - \gamma) w_g .$$

The stability condition can be illustrated in a diagram:



a) Stable wealth ratio,  
equation (18).



b) Unstable wealth ratio,  
equation (18).

Source: Rødseth (2000, p. 156)

Figure 2: Dynamics of government wealth ratio

Figure 2 shows the stable (a) and explosive (b) paths of the government wealth ratio's time paths. The dynamics are described by two opposing forces, interest rates and growth in GDP, for a constant surplus-to-GDP ratio. Accumulation of interests over time has an effect on the present level of surplus or debt. The effect is positive if there is a surplus, and negative if there is debt due to increased debt servicing costs. Growth in GDP make past deficits smaller relative to the present size of the economy, and help stabilise the wealth ratio as past deficits become less significant over time. The interest effect dominated when the real interest rate is larger than the growth rate of GDP, and the growth effect dominated when the growth rate exceeds the real interest rate.

To conclude, if the real interest rate exceeds the growth rate, balanced growth requires an adjustment, or response, in surplus-to-GDP when debt-to-GDP is altered. If this response is omitted, and the budget deficit is excessive, the ratio of foreign debt-to-GDP explodes. If, however, the real interest rate is lower than the growth rate, balanced growth is apparently possible to achieve regardless of the initial level of the primary surplus without the debt-ratio exploding.

### **3.2.2 Debt and fiscal policy within a monetary union**

Membership in a monetary union complicates an unsustainable debt path. One country's debt may have negative spillover effects on other countries access to capital markets. It may drive the interest rate upwards, if the capital markets are not functioning optimally. Furthermore, the increased interest rate may also affect the monetary policy conducted by the union's central bank – The European Central Bank. The risk of increased interest rate diminishes if the capital markets work properly. If this is the case, the correct risk premium will be attached to each country's bond price. Within a monetary union an implicit bail-out guarantee exists from the other member states in order to avoid a global debt crisis, and the country's risk premium is distorted. (Grauwe, 2007, pp. 227-228). The current example of this is Mario Draghi's (president of the European Central Bank) speech at the Global Investment Conference in London 26 July 2012 "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough".

Grauwe (2007, p. 225) points to Belgium and Italy in the 1990s and their experience from running large budget deficits which quickly leads to large government debt, and debt dynamics which are unsustainable as examples that “vividly demonstrate the limits to the use of fiscal policies to offset negative economic shocks”. Kirsanova, Satchi, Vines, and Simon (2007) on the other hand, show through a micro-founded model that “national fiscal policy can help to stabilise individual economies within a monetary union”.

Membership in monetary unions gives incentives to more discipline in fiscal policies. A sovereign country has the possibility to issue high-powered money, denoted as seignorage in the model by Rødseth (2000), in order to alleviate the budget constraint. Working in the opposite direction, there is a moral-hazard argument because a member state has less default risk, and has lost the power to devalue its currency, so when it acquires excessive debt the risk premium will not increase as much as a sovereign state. This can be shown empirically thorough “the average budgetary deficit of the member states in monetary unions tends to be lower than the average deficit of independent countries in the EC”. In conclusion, member states of a sovereign union face a “harder” budget constraint due the lack of issuing high-powered money, and a monetary union disciplines fiscal policy. (Grauwe, 2007).

### 3.3 How to test for fiscal sustainability?

To empirically test for sustainability of public finances in a country, a feedback rule for fiscal policy is the most common technique in the literature. The following sections are a summary of four different articles, mainly focusing on their empirical specification of the rules, and their results.

#### 3.3.1 Bohn 1998: The behaviour of U.S public debt and deficits

Bohn (1998) test the hypothesis of sustainability of fiscal policy in the U.S by means of an econometric equation that represents a fiscal rule. He examines the relationship between U.S government debt and primary surpluses from 1916-1995, and searches for a “systematic relationship between the debt-income ratio and the primary surplus”. The starting point for the analysis is the government’s period by period budget constraint,

$$(21) \quad D_{t+1} = (D_t - S_t)(1 + R_{t+1})$$

where  $D$  denotes debt,  $S$  the primary surplus and  $(1+R_{t+1})$  is the real interest factor. He rewrites the period by period budget constraint to ratios of GDP

$$(22) \quad \begin{aligned} d_{t+1} &= x_{t+1}(d_t - s_t) \\ x_{t+1} &= (1 + R_{t+1}) \frac{Y_t}{Y_{t+1}} \approx 1 + r_{t+1} - y_{t+1} \end{aligned}$$

Where lower case letters denote ratios of GDP, and  $y_{t+1}$  is the real growth rate and  $r_{t+1}$  the real interest rate. The sustainability test for fiscal policy is a regression based on the period by period budget constraint. The connection between debt-to-GDP ratio and the primary surplus becomes:

$$(23) \quad \begin{aligned} s_t &= \rho d_t + \alpha Z_t + \varepsilon_t = \rho d_t + \mu_t \\ \mu_t &= \alpha Z_t + \varepsilon_t \end{aligned}$$

where  $Z_t$  denotes other determinants of the primary surplus. Equation (23) “provides a new sustainability test that does not require interest rate assumptions”, further “It is valid in economies with uncertainty and risk aversion and for arbitrary debt management policies, whether or not government bond rates are above or below the growth rate”. (Bohn, 1998, pp. 960-961).

In order to avoid the possible omitted variable bias when estimating Bohn refers to Barro’s tax-smoothing model from 1979<sup>9</sup>. Barro’s model implies “that the non-debt determinants of the primary surplus are the level of temporary government spending,  $GVAR$ , and a business cycle indicator,  $YVAR$ ”. (Bohn, 1998, p. 951).

Bohn’s regression model becomes:

$$(24) \quad s_t = \rho d_t + \alpha_0 + \alpha_G GVAR_t + \alpha_Y YVAR_t + \varepsilon_t.$$

Regression equation (24) is estimated by Ordinary Least Squares (OLS) method.

Heteroskedasticity and autocorrelation corrected coefficient standard errors (HAC) are used for testing. After adjusting for cyclical factors and fluctuations in government spending, Bohn finds a significant and positive coefficient for debt in regression model (24). The economic implication of a positive and significant coefficient is that the government will react to an

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<sup>9</sup>Barro’s tax smoothing model can be found in: Barro, Robert J., “On the Determination of Public Debt,” Journal of Political Economy, LXXXVII (1979), 940-971.

increase in the debt-to-GDP ratio. The government response is to increase the primary surplus in order to curb the growth in debt. (Bohn, 1998, pp. 952-954).

One of Bohn's major concerns is the existence of a unit root in debt, i.e. that the variables are non-stationary (Kennedy, 2008, p. 302). However, Bohn show that the debt-to-GDP ratio is stationary for the U.S economy within the period Bohn tests for and that U.S fiscal policy is in fact sustainable and "sufficient to keep the debt-GDP ratio stationary in the future unless interest rates and growth rates move very unfavourably".

### **3.3.2 Favero and Monacelli 2005: Fiscal policy rules and regime (in)stability in the US.**

Favero and Monacelli (2005) study fiscal policy rules and regime (in)stability in the US. Their analysis differs from Bohn (1998) in two ways, they apply Markov-switching models to endogenise regime changes when they estimate fiscal policy, and do not rely on constant-regime assumptions. Secondly, they look at the policy mix between monetary and fiscal policy.

Much of the literature regarding policy regimes focus on monetary policy in isolation. Optimal rules for monetary policy often assume stability in the underlying fiscal policy regime. A regime where monetary policy is the main economic stabilisation mechanism, and underlying fiscal stability is assumed, is referred to as passive. Underlying fiscal stability implies that a sufficiently strong response to fiscal deficits to variations in real debt is taken for granted, or assuming that the government budget is balanced at all times. On the other hand, active regimes refer to a policy situation where debt exists and is stabilised<sup>10</sup>.

Favero and Monacelli proposes a specification of the fiscal rule "aimed at capturing a gradual convergence of the fiscal instrument (primary deficit in our case) to some specified target level, in a spirit similar to the one adopted recently for the estimation and analysis of so-called Taylor rules for monetary policy". The target deficit is assumed to feature a response to two main arguments; the output gap and the debt-stabilising deficit. The output gap captures the cyclical component of fiscal policy. The debt-stabilising deficit "allows to control for the time-varying effects of interest rate and growth rate of GDP on the debt-service component of

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<sup>10</sup> Favero and Monacelli follow Leeper (1991) for the terminology describing the different regimes. Policies that stabilise debt are "active" and policies that do not, are "passive". (Afonso, et al., 2011, p. 89)

the deficit”. The elasticity of the primary deficit to the debt-stabilising deficit captures whether fiscal policy is active or passive.

The final regression model is based on the government budget constraint:

$$(25) \quad B_t = (1 + r_t) B_{t-1} + D_t$$

where  $B_t$  is nominal debt,  $r_t$  is the average net nominal cost of debt, and  $D_t$  is the nominal primary deficit. The nominal government budget constraint, equation (25), says that current debt is equal to last periods debt plus interest payments plus the current primary deficit. Favero and Monacelli proceeds by expressing the budget constraint as ratios of GDP and in real terms:

$$(26) \quad b_t = \frac{(1 + r_t)}{(1 + g_t)} b_{t-1} + d_t$$

Where lower case letters express debt and deficit as fractions of GDP, and  $g_t$  is the growth rate of nominal GDP. Imposing  $b_t = b_{t-1}$  for all  $t$  becomes the debt-stabilising deficit:

$$(27) \quad d_t^* \equiv -\frac{(r_t - g_t)}{(1 + g_t)} b_{t-1}.$$

Equation (27) displays the debt stabilising deficit and shows how “the relationship between (past) debt and  $d_t^*$  depends on the difference between  $r_t$  and  $g_t$ ”. Dynamic efficiency, or sustainable debt, is characterised by a nominal growth rate of GDP exceeding the average net nominal cost of debt. If this is the case, a primary surplus is debt-stabilising.

The specification of the regression models becomes:

$$(28) \quad \begin{aligned} d_t &= \rho(s_t) d_{t-1} + (1 + \rho(s_t)) \bar{d}_t + v_t \\ \bar{d}_t &\equiv \gamma_0(s_t) + \gamma_1(s_t) d_t^* + \gamma_2(s_t) x_t \end{aligned}$$

Where  $\bar{d}_t$  is “the target level of the primary deficit,  $x_t$  is the output gap,  $v_t$  is an error term that captures discretionary exogenous deviations from the rule (interpretable as fiscal policy shock).  $s_t$  indicates that the coefficients (i.e., the features of the underlying fiscal regime) are allowed to evolve stochastically over time. This specification allows for identification of

different regimes in the conduct of fiscal policy. Through estimating a Markow-Switching model the probability of each regime (active or passive) can vary endogenously, and it renders it possible to identify in which time periods fiscal policy has been either active or passive. The specification also implies that government debt and primary deficit is non-linearly related. The output gap is included to control for the cyclical component, and the measure of the fiscal instrument is actual deficit.

After estimating regression model (28) Favero and Monacelli find that fiscal policy in the US can be classified as active through most of the period and passive fiscal policy is found between 1974Q4-1975Q2 and 1995Q2-2001Q2. The coefficient for the debt stabilising deficit,  $\gamma_1$ , characterises the different regimes. The regime where  $\gamma_1$  is positive, significant and close to 1 is labelled “passive” according to the terminology above. Under the passive regime the deficit will decrease in order to stabilise the debt-to-GDP level, and curb further growth in debt-to-GDP. Under the active regime primary deficit will increase and it exist a destabilising response of the primary deficit to the debt-stabilising deficit.

Favero and Monacelli also apply the regression model with constant regime expectations and their findings are consistent with Bohn (1998) “a generally passive fiscal policy in the US post-war history”. This, however, is inconsistent with the results of the Markow-Switching model which found that fiscal policy has mainly been active throughout the period. Considering the historical aspect and fit of the data, the discrepancy between the regression models may favour a regression model that does not have constant regime expectations.

The specification of the fiscal rule as in the first line in equation (28) is subject to two types of simultaneity. First, there is a potential joint dependence between primary deficit and debt. Second, there is a potential simultaneity between output gap and deficit because the fiscal shock,  $v_t$ , may be correlated with the output gap.

The simultaneity problem is addressed by first acknowledging that the debt-stabilising deficit allows to instrument current debt with lagged debt as is done in equation (27). Second, the debt-deficit simultaneity bias is likely to be present in both regimes (active and passive) so they conclude that there will be no difference in the estimated coefficients. The simultaneity bias between the fiscal policy shock and output gap is threatened by instrumenting the output gap via its own lagged values. This will “disentangle the effect of output fluctuations on the fiscal rule from the effect of the fiscal shock on output”.

### 3.3.3 Afonso, Sousa and Claeys 2011: Fiscal regime shifts in Portugal

Afonso, et al. (2011) estimate fiscal regime shifts in Portugal in the same manner as Favero and Monacelli (2005) do for the US economy explained in the previous section. They find evidence of a deficit bias and pro-cyclical government budgets in the Portuguese economy in the period 1978-2002.

Government debt and budget deficits are driven by both long-term trends and short term fluctuations. To model changes in fiscal policy they use a fiscal policy rule, or reaction function, that captures the response to government debt and the business cycle. They utilise the debt-stabilising budget surplus because it captures both the long-term trends and the short-term fluctuations in government debt.

The budget surplus at time  $t$  becomes

$$(29) \quad s_t = t_t - g_t,$$

where the budget surplus,  $s_t$ , is given as the difference between government revenue,  $t_t$ , and government spending,  $g_t$ . All variables are expressed as ratios to GDP.

The government budget constraint is given by

$$(30) \quad b_t \equiv \frac{(1+r_t)}{(1+y_t)} b_{t-1} - s_t,$$

The change in debt over time,  $b_t$ , is dependent on the primary surplus, and the accumulation of past interest payments on debt which is dependent on the difference between the real interest rate,  $r_t$ , and the real economic growth rate,  $y_t$ . Equation (30) says that if economic growth exceeds the interest payments, a budget deficit still coincides with debt stabilisation. On the other hand if the real interest rate exceeds the real economic growth rate the debt increases.

To keep the debt-to-GDP ratio constant over time the surplus has to equal

$$(31) \quad \bar{s}_t \equiv \frac{(r_t - y_t)}{(1 + y_t)} b_{t-1}.$$



Equation (31) defines the debt stabilising surplus  $\bar{s}_t$  as a fraction of GDP. Increased real interest rates, or suppressed real growth rates, will increase the requirement for the debt stabilising output. In Portugal, high real interest rates and inferior growth rates made the requirement for debt stabilising budget surplus 15% of GDP in the 1980's. As interest rates started to converge to the EMU level and Portugal's credit rating improved, growth also started to increase, which made the debt stabilising surplus stabilise at around 2% of GDP.

The behaviour of fiscal policy in Portugal is presented by a fiscal rule. The fiscal rule is derived from a fiscal reaction function, and its response to government debt and the business cycle, given by equation (32):

$$(32) \quad \hat{f}_t = f^* + \gamma(y_t - y^*) + \theta(b_t - b^*)$$

Where  $f^*$  is the long term fiscal target,  $b^*$  the long term debt target and  $y^*$  the long term output target.  $\hat{f}_t$  is the deviation from the target due to discretionary policy responses in addition to those of the normal fiscal stabilisers. However, fiscal policy will only gradually adjust to its target level according to

$$(33) \quad f_t = \rho f_{t-1} + (1 - \rho) \hat{f}_t + v_t.$$

Substituting (33) into (32), and adding and subtracting  $\bar{y}$  yields the fiscal rule

$$(34) \quad f_t = \rho f_{t-1} + (1 + \rho) [\kappa + \gamma x_t + \theta b_t] + v_t.$$

Where

$\kappa = f^* - \gamma(y^* - \bar{y}) - \theta b^*$  is a constant

$x_t = y_t - \bar{y}$  is the output gap

The constant term,  $\kappa$ , can be interpreted as “a long-term fiscal indicator: it adjusts the target surplus for the deviation between the government's output target and long-term potential output, and for the government debt target”. Further the authors state “deviations from the rule, which are captured by the residual term,  $v_t$ , are discretionary changes in systematic fiscal policy”.

The final specification of the fiscal rule is characterised by the definition of the fiscal instrument  $f_t$  as the primary surplus-to-GDP ratio  $s_t$ , and that they, as Favero and Monacelli (2005), substitute debt,  $b_t$ , with the government debt-stabilising surplus,  $\bar{s}_t$ . The final specification is then given by equation (35):

$$(35) \quad s_t = \rho s_{t-1} + (1 - \rho) [\kappa + \gamma x_t + \theta \bar{s}_t] + v_t.$$

The fiscal rule that equation (35) presents is a “non-linear fiscal rule that implicitly controls for the time-varying effects of interest rates and growth in the debt service component of the deficit that are not under the direct control of the government”.

Fiscal policy is passive, in the same sense as in section 3.3.2, when the coefficient associated to the debt stabilising surplus,  $\theta$ , is not statistically different from one. The economic implication of  $\theta=1$  is a budget that is always in balance, i.e. a sufficiently high response in surplus from increased debt to stabilise debt. When this criteria is not satisfied,  $\theta < 1$ , the reaction in primary surplus is less than proportional to the rise in debt, and fiscal policy is active. The constant term,  $\kappa$ , should not be statistically different from zero. A constant term statistically different from zero implies a non-zero surplus and cause trend growth in debt.

The fiscal rule, regression model (35), is estimated as a Markow-Switching model in order to test whether there are regime changes. The cyclical response in each fiscal policy regime is classified as pro-cyclical, countercyclical or a-cyclical. These three states are decided by the coefficient for the output gap,  $\gamma$ , deviation from the cyclical elasticity of the budget. For Portugal this elasticity is 0,46 which is slightly below the OECD average of 0,5. If  $\gamma=0,46$  automatic stabilisers are let to work, a  $\gamma > 0,46$  and fiscal policy is countercyclical, a  $\gamma < 0,46$  and fiscal policy is pro-cyclical, and a statistically insignificant  $\gamma$  implies a-cyclical fiscal policy.

For Portugal they find a “once and for all” regime shift in 1988. An active and a-cyclical fiscal policy changes to a slightly more passive and pro-cyclical fiscal policy after 1988, but the fiscal policy remains unsustainable and both regimes can be classified as active because the change is not significant for the debt response. The period before 1988 is characterised by high deficits, and a lack of both debt responses and cyclical responses in primary surplus. The period after 1988 can be split into two, both regimes are active but switching between pro-cyclical (regime 2) and a-cyclical (regime 3) policies. Under regime 2 the surplus is set to

correct deviations in debt, but the average deficit is still too large for this policy to be sustainable. In contrast, in regime 3, the average deficit is much smaller, but the reaction of the primary surplus is less than proportional.

### **3.3.4 Claey's 2008: Rules, and their effects of fiscal policy in Sweden.**

Claey's (2008) classify fiscal rules into two different groups, where both have the objective of obtaining a sustainable path for public finances. The first group "imposes numerical deficit or debt targets. Balanced budget rules, a golden rule, debt brakes etc. all belong to this class". The second group of rules impose institutional changes to improve budgeting procedures.

Sustainability is defined as "the public sector does not leave public assets or liabilities with any positive probability, i.e., the sum of the present discounted value of expected future primary surpluses suffices to pay off current debt."

The point of origin for Claey's' model is an analysis of the intertemporal budget constraint, and the transversality condition. "The sustainability condition is met when the public sector does not leave any public assets or liabilities with a positive probability", this is when the transversality condition holds. The equivalent time series test for fiscal sustainability is cointegration between the primary surplus and public debt, which implies that the total government deficit series is stationary. A stationary deficit series implies that undiscounted public debt is finite in the long run. The concept of cointegration will be discussed thoroughly in section 4.2.

The relation between surplus and debt is specified as a fiscal reaction function (in the same manner as Bohn (1998)):

$$(36) \quad s_t = \theta b_t + \mu_t .$$

In equation (36)  $s_t$  denotes the primary surplus and  $b_t$  is the debt and  $\mu_t$  is an error term. Equation (36) is equivalent to the method of Bohn (1998) treated in section 3.3.1, where he proves that a country's (the U.S) fiscal policy is sustainable if the primary surplus reaction to public debt is strictly positive. Claey's refers to the "fiscal theory of the price level" or

passive<sup>11</sup>, non-ricardian, regimes as an alternative way to satisfy the intertemporal budget constraint.

He regards the “fiscal theory of the price level” as too “sanguine” and selects a less debated approach and redefines the fiscal rule in terms of the debt stabilising surplus. The debt-stabilising surplus becomes

$$(37) \quad \bar{s}_t = \frac{q_t - k_t}{1 + k_t} b_{t-1}.$$

Equation (37) implies that “if nominal GDP growth ( $k_t$ ) exceeds the interest cost of debt ( $q_t$ ), persistent deficits are still consistent with debt stabilisation as real economic growth and inflation outgrow the interest payments”.

Fiscal policy is decomposed into a structural and a cyclical component. The cyclical component includes the reduction of unemployment benefits, transfer payments and increased tax in an economic boom. The structural component is mainly due to discretionary fiscal policy, i.e. when governments “fuel a boom by lowering taxes or increasing spending, or lean against the wind by raising tax revenue and cutting spending”.

$$(38) \quad f_t \equiv \hat{f}_t + \alpha y_t.$$

In equation (38),  $\hat{f}_t$  is the structural component and  $\alpha y$  is the cyclical component where  $\alpha$  is the elasticity of the fiscal indicator with respect to output.

Claeys’ empirical specification to characterise fiscal policy behaviour is based on a primary surplus-to-GDP target of the government  $s_t^*$ , based on a long-term level,  $s^*$ , but also varies in response to cyclical conditions and public debt.

$$(39) \quad s_t^* = s^* + \gamma(y_t^e - y^*) + \theta(b_t - b^*).$$

“The surplus target (equation (39)) fluctuates in response to expected deviations of output  $y_t^e$  from the desired target output level  $y^*$ . The output response  $\gamma$  does not only capture the automatic stabilisation responses of some spending and revenue categories; it also includes the systematic discretionary intervention of the government to cyclical conditions. If the

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<sup>11</sup> The fiscal theory of the price level is a third regime which has attracted much attention recently. “The intertemporal budget constraint is satisfied only at the equilibrium price level, and the government’s debt plays a critical role in determining the price level. (Walsh, 2003, p. 145).

government just lets the automatic stabilisers work over the cycle, then  $\gamma=\alpha$ . The government also attaches some direct weight on debt by keeping under control deviations of debt  $b_t$  from a steady state long-term level for debt  $b^*$ .

The fiscal instrument is assumed to gradually adjusts to its target level:

$$(40) \quad s_t = \rho s_{t-1} + (1 - \rho) s_t^* + v_t .$$

This gradual convergence combined with the surplus target (equation (39)) yields the following non-linear relation between the surplus and public debt.

$$(41) \quad s_t = \rho s_{t-1} + (1 - \rho) [s^* - \gamma(y^* - \bar{y}) - \theta(b^* - \bar{b}) + \gamma(y_t - \bar{y}) + \theta b_t] + v_t$$

Equation (41) is simplified by the following definitions:

$$(42) \quad \begin{aligned} \omega &= s^* - \gamma(y^* - \bar{y}) - \theta(b^* - \bar{b}) \\ x_t &= y_t - \bar{y} \end{aligned}$$

$\omega$  represents a “long-term fiscal indicator adjusted for the deviation between the government’s output (debt) and long-term output (debt)”.  $x_t$  is the output-gap. The baseline empirical specification and regression model becomes:

$$(43) \quad s_t = \rho s_{t-1} + (1 - \rho) [\omega + \gamma x_t + \theta b_t] + v_t$$

The residual term,  $v_t$ , can be interpreted as fiscal policy shocks, i.e. “discretionary exogenous deviations from the rule”.

Claeys find that fiscal policy in Sweden is not sustainable after estimating a baseline fiscal rule, in which the government stabilises debt with the primary surplus. The Swedish government does not raise its primary surplus sufficiently to pay off outstanding debt. The response is neither significant nor positive, suggesting that deficits have been growing along with debt. He also finds that the budget is “remarkably responsive to the cycle: a 1 per cent improvement in the output-gap strengthens the budget position by about 1,40%. This strongly pro-cyclical effect is known – as in other Scandinavian countries – to largely be the effect of the extensive welfare state and large automatic stabilisers built into the unemployment system. Claeys has found an active fiscal policy in Sweden, which ignores debt.

Claeys extends his model with a Markow-Switching model to identify regime changes, and classify regime changes over time.

# 4 Fiscal sustainability in Portugal

## 4.1 Non-stationarity

Most macroeconomic data are non-stationary, and are often characterised by deterministic trends, a broken trend or by a so called stochastic trend. A “random walk” is the simplest example of a stochastic trend, where this period’s variable is equal to last period’s variable (usually called a lagged variable) plus a random error. Many econometricians, according to Kennedy (2008, pp. 301-302), build their model on the assumption that “the non-stationarity is such that differencing will create stationarity”. Differencing will remove a deterministic trend as well as well as a stochastic trend, but often it is the latter alone that motivates the differencing.

A variable is said to be integrated by order  $d$ , denoted  $I(d)$ , if it needs to be differenced  $d$  times to become stationary. A stationary variable is then  $I(0)$  because it has to be differentiated 0 times to become stationary, and a “random walk” variable is  $I(1)$  so it has to be differentiated once to become stationary. (Kennedy, 2008, p. 302). Variables that are  $I(1)$  have unconditional variances that are proportional to  $t^{1/2}$  and the variables will diverge as  $t \rightarrow \infty$ , and they are never expected to obey any sort of long-run equilibrium relationship. (Davidson & MacKinnon, 1993, p. 716).

Non-stationarity is problematic from an econometric point of view because asymptotic theory is not applicable and it might create a spurious regression, i.e. failing to remove the stochastic trend from the non-stationary dependent variable (Favero, 2001, pp. 45-47). Kennedy (2008, p. 301) describes spurious results as “results that erroneously indicate (through misleading use of  $R^2$ , Durbin-Watson and t-statistics) that a meaningful relationship among the regression variables exists”. Therefore it is important to test for non-stationarity before proceeding with the estimation.

Non-stationarity is often related to the existence of a “unit root”, i.e. random walk. The economic implication of a unit root is that a shock will persist forever. (Favero, 2001, p. 47).

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<sup>12</sup> The sample size

To see the stochastic properties of a random walk variable we first establish the solution of the associated difference equation, e.g., by repeated substitution.

Specifically we have that

$$(44) \quad \begin{aligned} s_t &= s_{t-1} + \varepsilon_t \\ s_{t-1} &= s_{t-2} + \varepsilon_{t-1} \\ s_{t-2} &= s_{t-3} + \varepsilon_{t-2} \end{aligned}$$

After substitution the relationships in (44) can be expressed as

$$(45) \quad s_t = s_{t-3} + \varepsilon_{t-2} + \varepsilon_{t-1} + \varepsilon_t$$

Continuing the substitution back to  $s_0$  we get the solution

$$(46) \quad s_t = s_0 + \sum_{i=1}^T \varepsilon_{t-i}$$

for the random walk variable  $s$ . The variable at time  $t$  is equal to the initial value,  $s_0$ , plus the sum of the disturbance terms. Since the disturbances are stochastic this part is called a stochastic trend.

A generalization of (46) is to include a constant, and the generalised process is called a “random-walk with drift”. The exposition of a random walk with drift is similar to the one we have just given, and the known relationships with a constant are:

$$(47) \quad \begin{aligned} s_t &= \gamma + s_{t-1} + \varepsilon_t \\ s_{t-1} &= \gamma + s_{t-2} + \varepsilon_{t-1} \\ s_{t-2} &= \gamma + s_{t-3} + \varepsilon_{t-2} \end{aligned}$$

Through substitution (47) can be expressed as

$$(48) \quad s_t = \gamma + \gamma + \gamma + s_{t-3} + \sum_{i=1}^T \varepsilon_{t-i} .$$

The solution to (48) becomes

$$(49) \quad s_t = \gamma + s_0 + \sum_{i=1}^T \varepsilon_{t-i},$$

where  $\gamma$  is the sum of all the constant terms and shows that the solution contains a deterministic trend. The value  $s$  takes at time  $t$  is equal to the sum of the initial value plus both the deterministic trend and the error terms.

From (46) and (49) we see for example that the white noise disturbances will imply that both the expectation and the variance of the  $s$  variables will depend on time, while stationarity require that these two moments do not depend on time.

The term “unit-root” also has a mathematical interpretation and it comes from difference equations with constant coefficients. Equation (44) is a special case of

$$(50) \quad s_t = \beta s_{t-1} + \varepsilon_t$$

where  $\beta$  is called the autoregressive parameter, which is set to 1 in (44). Equation (50) is a first order difference equation. The associated characteristic equation is

$$(51) \quad \lambda - \beta = 0,$$

where  $\lambda$  is the characteristic root, also called an eigenvalue. In this simple case the expression for the eigenvalue is

$$(52) \quad \lambda = \beta$$

In the random walk (with or without drift)  $\beta = 1$ , meaning that the root is one, or unity.

The Dickey-Fuller (DF) and Augmented Dickey Fuller (ADF) tests are the conventional tests for the null hypothesis of unit-root and non-stationarity in a time series. An example is given in Favero (2001, p. 47) for a time series variable  $x_t$ . The test is based on the regression model:

$$(53) \quad x_t = \mu + \gamma + \delta x_{t-1} + \sum_{i=0}^k \varphi_i \Delta x_{t-i-1} + \varepsilon_t$$

The error-term in (53) has so called classical properties (expectation zero, time independent variance and no autocorrelation).



Under the unit-root null hypothesis  $\delta = 1$ , the test statistic is defined by <sup>13</sup>

$$(54) \quad \tau \equiv \frac{(\hat{\delta} - 1)}{SE(\hat{\delta})}$$

where  $\hat{\delta}$  is the estimated coefficient from running Ordinary Least Square, henceforth OLS, on regression model (53). The denominator is the standard error of the estimated coefficient.

A rejection of the null-hypothesis implies that the variable is stationary, but we have to note carefully that the test-statistic is not t-distributed under the null hypothesis of non-stationarity.

The ADF test statistic is obtained by selecting an appropriate value for k in the regression model, in the DF test k=0.

The appropriate asymptotic critical values for the Dickey-Fuller test are provided by e.g. Mackinnon (1991) and are dependent on the specification of the regression model. There exist three different types of test statistics; “no constant”, “constant, no-trend” and “constant, with trend”, denoted respectively  $\tau, \tau_c, \tau_t$ . The requirement to reject the null hypothesis becomes stricter if there is a constant and even stricter if the model also includes a trend. The exact sample size is also important for calculating the critical values. The formula for the critical values and the table for response surface estimates of critical values are available in Davidson and MacKinnon (1993, pp. 272, 275 table 1).

## 4.2 Cointegration

If a variable is treated as non-stationary after use of the Dickey-Fuller test, one solution is to differentiate the variable until it becomes stationary, and estimate a regression of only stationary and differenced variables. However, this approach will take away valuable information about the potential long-term equilibrium relationships between the variables. A second solution is cointegration. Cointegration is based on the observation that some variables

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<sup>13</sup> I follow Davidson and MacKinnon (1993, p. 703) who refer to the test static in Dickey-Fuller test as  $\tau$ -statistics rather than t-statistics to avoid confusion because it will not follow the Student's t-distribution.

may be non-stationary,  $I(1)$ , but a linear combination of them will be stationary,  $I(0)$ , see e.g., Kennedy (2008, pp. 302-303).

Davidson and MacKinnon (1993, pp. 715-722) provides a good exposition of cointegration and cointegration tests. The following sections will follow their exposition closely and present their test for cointegration.

Davidson and MacKinnon motivate the use, or existence of, cointegration through economic theory; “economic theory often suggest that certain pairs of economic variables should be linked by a long-run equilibrium relationship. Although the variables may drift away from equilibrium for a while, economic forces may be expected to act so as to restore equilibrium”. Examples of such pairs of variables are disposable income and consumption, government spending and tax revenues, and wages and prices.

The requirement for cointegration is that the disequilibrium term defined by the suggested long-run relationship is stationary,  $I(0)$ . This implies that testing for cointegration is a unit root test on the error term. The null hypothesis will be non-cointegration, with error term  $I(1)$ , the alternative is cointegration, with error term  $I(0)$ . This type of test is usually referred to as *residual-based cointegration test*. The simplest procedure is the Engle-Granger test. The test involves first estimating the cointegrating regression by OLS and then using the Dickey Fuller  $\tau$ -test, based on the regression

$$(55) \quad \Delta \hat{v}_t = (\alpha - 1) \hat{v}_{t-1} + e_t$$

Where  $\hat{v}_t$  is the residual in the cointegration regression and  $\alpha$  is the regression coefficient, equivalent to  $\delta$  above.

Another approach described by Davidson and MacKinnon (1993, pp. 723-724) is to formulate an error-correction model, henceforth ECM, and test whether the error-correction term is  $I(0)$ . This is the approach I will use to test for cointegration in in section 4.6.

### 4.3 Description of the DATA<sup>14</sup>.

The empirical work is applied to an annual dataset that I have compiled from the European Commission's annual macroeconomic database, AMECO and the Bank of Portugal's statistical database. The time series starts in 1977 and ends in 2011.

For analysing debt sustainability I have collected observations for the three variables:

$s_t$ : Primary balance - as a percentage of GDP. The figures are from the Bank of Portugal's statistical database.

$b_t$ : General government consolidated gross debt. The figures are based on the definition "ESA 1995" and former definitions prior to 1995. The figures are from the AMECO database.

$x_t$ : The output gap. The output-gap has been made with a HP-filter in OxMetrics. I have used the same smoothing coefficient ( $\lambda$ ) as Banco de Portugal<sup>15</sup>,  $\lambda=30$  for annual data, and  $\lambda=7680$  for quarterly data. The figures for output are GDP at 2005 market prices from the AMECO database.

In addition to the variables described above I will include some dummy variables in order to control for regime-shifts, or more temporary but large changes in expectations, due to exogenous economic or political events that have had an impact on the Portuguese economy.

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<sup>14</sup> All empirical results are from PcGive v. 13 for OxMetrics developed by Jurgen A. Doornik. Information available at <http://www.pcgive.com/pcgive/index.html>

<sup>15</sup> I e-mailed my former professor at NOVA school of Business and Economics, João Amador, who is an economist in Banco de Portugal's (Portugal's Central Bank) research department, division for public finances and structural issues and he sent me the official  $\lambda$  values that Banco de Portugal use.

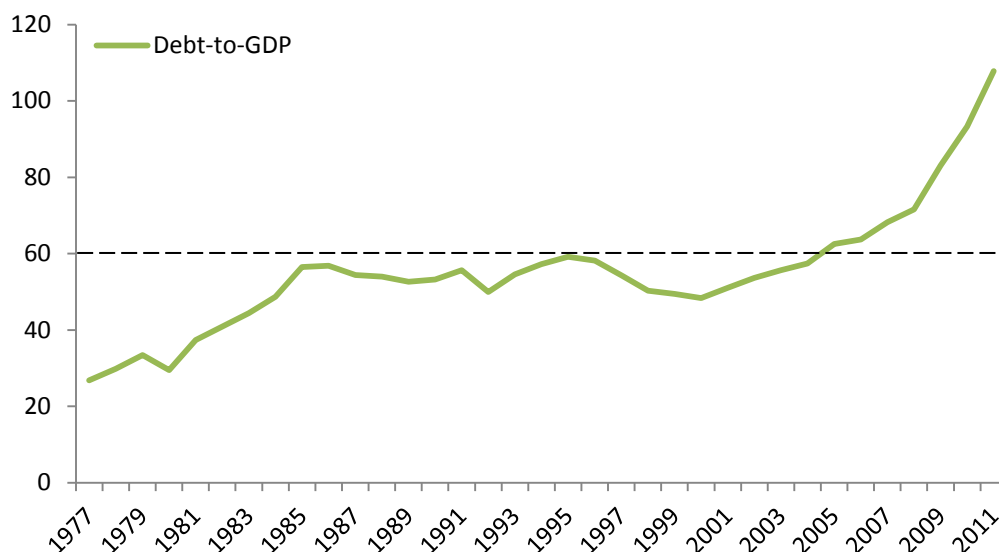


Figure 3: The annual debt-to-GDP ratio.

Figure 3 shows the annual debt-to-GDP ratio in the Portuguese economy from 1977 until 2011. Connecting this to the section about Portugal's economic history the gradual build up in the debt-to-GDP ratio from the end of the 1<sup>st</sup> IMF round until after the 2<sup>nd</sup> IMF round in 1984 is clearly illustrated. After EU membership in 1985 the ratio stabilises and manages to stay below 60% of GDP, which is the Maastricht criterion. Debt-to-GDP rises to more than 60% in 2005 and has continued to rise since, reaching 107.9% of GDP in 2011. Analysing the trend, or accumulation of debt, through time, raises the suspicion of debt-to-GDP being a random-walk variable.

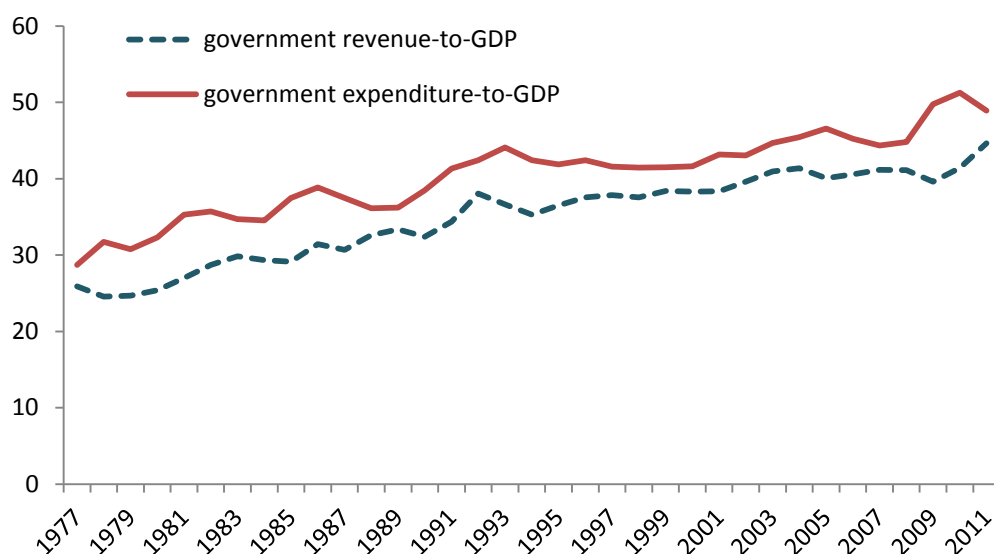


Figure 4: Government revenue-to-GDP and government expenditure-to-GDP.

Figure 4 shows the continuous gap between revenue (broken line) and expenditure (solid line), and illustrates the reason behind the debt accumulation. The increase in government revenue due to the privatisation reform in 1989-1990 is clearly shown, as are the counteractive measures undergone in 2009 and 2010 to reduce the impact of the global financial crisis.



Figure 5: Government annual primary surplus-to-GDP ratio.

Figure 5 shows the fluctuation in the budget surplus-to-GDP ratio. A period of budget deficits until 1986 are followed by a period of surpluses from 1986 and the 3<sup>rd</sup> oil shock and privatisation reforms until 1993. The budget surplus-to-GDP ratio managed to stay above the 3% deficit requirement from the Maastricht criteria until 2004. The impact of the global financial crisis in 2009 is also clearly illustrated here.

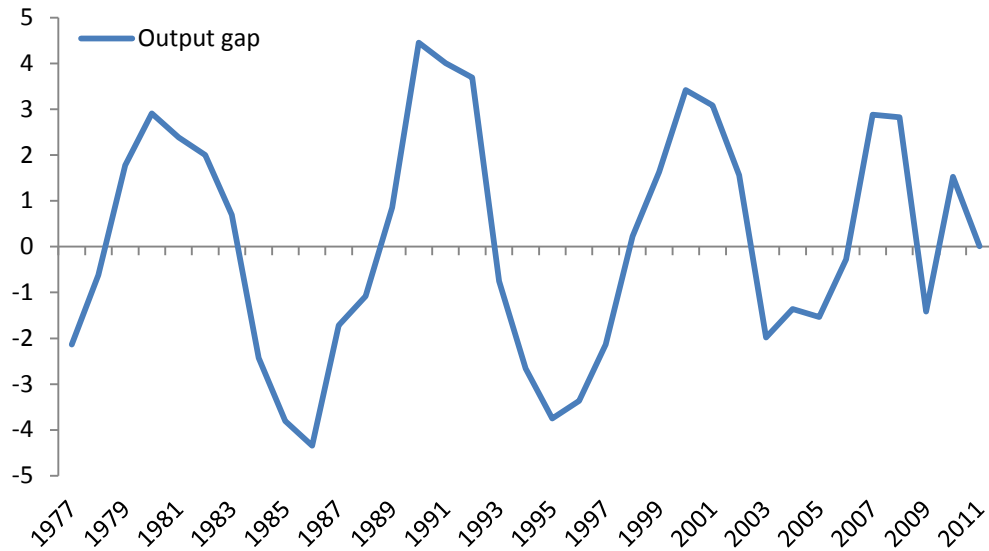


Figure 6: Output gap.

Figure 6 shows the output-gap from 1977 until 2011. The impact of the 3<sup>rd</sup> oil shock in 1986 initiated an upswing in the Portuguese economy. Another upswing was after Portugal qualified for the Euro-zone. The impact of the global financial crisis in 2009 is also illustrated.

## 4.4 Testing for a unit root in Portuguese fiscal data.

Before starting on the regression model I check whether the data is stationary or not. I perform a unit root test on the surplus-to-GDP ratio and the debt-to-GDP ratio both for the annual and quarterly data.

To test for the unit root in the surplus-to-GDP ratio I formulate two regression models

$$(56) \quad s_t = \alpha_0 + \rho s_{t-1} + \varepsilon_t$$

$$(57) \quad s_t = \alpha_0 + \gamma t + \rho s_{t-1} + \varepsilon_t$$

Where  $s_t$  is the surplus-to-GDP ratio,  $\rho$  is the regression coefficient and  $\varepsilon_t$  is the error term. Regression model (57), as opposed to (56), contains a trend,  $\gamma t$ . My null hypothesis is that there exists a unit root, and I test the alternative hypothesis that there is no unit root so that surplus-to-GDP is a stationary variable for the two regression models.

$H_0: \rho=1$  vs  $H_1: \rho<1$ .

Kennedy (2008, p. 303) says that the usual alternative hypothesis is  $\rho<1$  because a  $\rho>1$  would imply explosive solutions. (Although that view excludes forward-looking behaviour and rational expectations, which relies on  $\rho>1$ ).

When testing for a unit root the common practice is first estimate (56) by Ordinary Least Squares, henceforth OLS, to see the goodness of fit of the regression model and the misspecification tests, and then do the Dickey-Fuller test described above. After the goodness of fit and misspecification tests are accepted, it is common to review the Dickey-Fuller test with a higher degree of augmentations. The Dickey-Fuller test with a higher degree of augmentations is implemented in the econometric software package PcGive for OxMetrics.

The results from estimating (56) in PcGive with OLS, are reported in Table 2.

Table 2: OLS estimation of surplus-to-GDP ratio. Estimation period is 1977-2011.

		Coefficient	S.E	t-statistic	P-value
S <sub>t-1</sub>		0.592332	0.1426	4.15	0.0002
Constant		-0.440062	0.3987	-1.10	0.2779
$\hat{\sigma} = 2,11531$		T=34	R <sup>2</sup> = 0,3501	F[1,32] = 17,24 [0,000]**	
$\chi^2_{\text{norm}}[2] = 6.1260 [0.0467]^*$			F <sub>het</sub> [2,31] = 0.18639 [0.8309]		
F <sub>ar(1-2)</sub> [2,30] = 1.7734 [0.1871]			F <sub>hetx</sub> [2,31] = 0.18639 [0.8309]		
F <sub>arch(1)</sub> [1,32] = 0.034154 [0.8545]					

Table 2 shows that the regression model has 34 observations and 2 parameters. The reported standard error of the model,  $\hat{\sigma}$ , is 2,115.  $R^2$  is the regression model's explanatory power, given by

$$(58) \quad R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS}$$

where ESS is the explained sum of squares, TSS is total sum of squares, and RSS is residual sum of squares.. The interpretation of the reported  $R^2$  is that the estimated model, lagged surplus-to-GDP and a constant, explains 35,01% of the variation in surplus-to-GDP at time t.  $R^2$  will always increase in value when another variable is included. Adjusted  $R^2$  corrects for the number of parameters included in the model, but it does not have the "goodness of fit"

interpretation as the unadjusted  $R^2$  do. Therefore, the adjusted  $R^2$  will only be included as a reference where it is necessary to have in mind that the reported  $R^2$  may be “untruthful high”.

The reported F-test is a test for the joint null-hypothesis that all regression coefficients are equal to zero, versus the alternative that at least one of them is different from zero, excluding the intercept. The F-test tests the overall significance of the regression model. The reported value of the test-statistic is 17,24, and the p-value is reported in brackets. The p-value shows the probability of the variable being different from its critical value. A reported p-value of 0,001 implies that the null hypothesis can be rejected at a 99% level of significance. A reported p-value of 0,005 implies that the null-hypothesis can be rejected at the 95% level of significance, and so forth. Since the reported p-value is zero, it is possible to reject the null-hypothesis at a 99% confidence level.<sup>16</sup>

The explanatory variable  $s_{t-1}$ , which is the lagged value of the surplus-to-GDP ratio, has a coefficient of 0,592, with a standard error of 0,142. The interpretation of the coefficient value is that a one unit increase in lagged surplus-to-GDP creates an increase of 0,59 in the current surplus-to-GDP. The variable is significantly different from zero, with a P-value equal to 0,0002 lagged-surplus is a significant explanatory variable at the 99% level of significance.

The last section of Table 2 is a series of misspecification tests. The misspecification test evaluates the classical assumptions made for the error term.  $F_{ar(1-2)}$  test is a test for autocorrelation among error terms.  $F_{arch(1)}$  is a test for *auto regressive conditional heteroskedasticity*.  $\chi^2_{norm}$  is a normality test, or Jarque-Bera test, for error-term distribution, that they are normally distributed around the mean, and not skewed, or have a kurtosis. The  $F_{het(X)}$  tests are White’s test for heteroskedasticity. A good presentation of misspecification tests is provided by Bårdsen and Nymoen (2011) .

When we are using times series data, the most common violation of the classical assumptions is residual auto-correlation Auto-correlated error-terms entails that the estimated variance of the OLS estimators are no longer correct. The result is that the t-statistic becomes biased, and

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<sup>16</sup> The critical values for the F-distribution and student’s t-distribution are found in e.g. Hill, Lim, and Griffiths (2008), this also includes all future references to the critical values of the F-distribution and student’s t-distribution.



the basis for the statistical test has disappeared. With positive autocorrelation, the null-hypothesis will be rejected more often at a 5% level of significance than is true. The most common test for auto-correlation in error-terms is the Durbin-Watson test-statistic. The test reported in Table 2 for auto-correlation is based on the auxiliary regression and follows an F-distribution.

The paragraph above is correct for static models, but the model considered here is dynamic since a lagged variable is included. One of the problems that arise when estimating a dynamic model is that OLS will not create an unbiased estimator. This is true for stationary time series. (Davidson & MacKinnon, 1993).

If the normality assumption about the error term does not hold, the distribution of the test-statistic is unknown. The normality test-statistic has a  $\chi^2$ -distribution. The critical values for this distribution are available in Hill, et al. (2008).

If the assumption of heteroskedastic error-terms does not hold, the OLS estimator will still be unbiased and consistent, but the true variance of the estimated coefficient,  $\hat{\rho}$ , may be biased. The square root of the variance is used when testing hypotheses and the calculated test-statistic may then become wrong, and a variable may be regarded as insignificant because the estimated standard error is too high. The test-statistic follows an F-distribution.

Autoregressive conditional heteroskedasticity is a form of heteroskedasticity that is particularly relevant for time-series data. The variance of the disturbance in a time-series model may be dynamic, i.e. follow a time trend.

The unit-root test-statistic is

$$(59) \quad \tau_c = \frac{(\hat{\rho} - 1)}{se(\hat{\rho})} = \frac{0,592332 - 1}{0,1426} = -2,85$$

and has a critical value according to the Dickey-Fuller distribution with 34 observations, and a constant,

$$(60) \quad DF_{(C,1,34)} = -2,8321 + \frac{-2,738}{34} + \frac{-8,36}{34^2} = -2,94$$

at the 95% confidence level (Mackinnon, 1991). The  $\tau_c$ -statistic is not below the critical value at the 95% level and it is therefore not possible to reject the null hypothesis of a unit root. The conclusion is that the surplus-to-GDP ratio is a non-stationary variable; it has a unit root and is a “random walk”.

The unit-root test provided above is for 0 degrees of augmentation, equivalent to  $k=0$  in equation(46). The Dickey Fuller test for a unit root with a higher degree of augmentation is provided in tTable 3, for 32 observations, with both a constant term, and a constant and a trend;

D-lag	$\tau_c$ -ADF <sup>a</sup>	$\tau_t$ -ADF <sup>b</sup>
2	-1.728	-1.674
1	-2.992*	-3.029
0	-2.934	-3.065

<sup>a</sup> Test-statistic for constant with critical values:  
5% = - 2.96 1% = -3.65. T=32.

<sup>b</sup> Test-statistic for constant and trend with critical values: 5% = -3.56 1% = -4.27. T=32.

The augmented Dickey-Fuller (ADF) test uses the lagged differences in the surplus-to-GDP ratio. In order to show that the conclusion is not biased by omission of a trend I have also included the critical values for the Dickey-Fuller test including trend. The critical values are provided by the PcGive as -2,96 at a 95% confidence level for the model with a constant, and -3,56 at 95% level for the model with both a constant and a trend. It is not possible to reject the null hypothesis at the 99% level for any of the augmentations. This confirms the conclusion above, that the surplus-to-GDP ratio is non-stationary.

The economic implication of a non-stationary surplus-to-GDP ratio is that it is a random walk, and that its current value is equal to the initial value plus the sum of all error-terms. According to Favero and Monacelli (2005) the error-terms are possible to interpret as fiscal policy shocks.

In order to test for a unit-root in the debt-to-GDP ratio I will apply the same procedure as for the surplus-to-GDP ratio, but substitute for surplus-to-GDP with debt-to-GDP in equations (56) and (57).

The results from the regression model for debt including a trend are reported in Table 4

Table 4: OLS estimation of debt-to-GDP ratio with trend.<sup>a)</sup>

Table 1: OLS estimation of debt to GDP ratio with trend.				
	Coefficient	S.E	t-statistic	P-value
b <sub>t-1</sub>	1.10723	0.09452	11.7	0.0000
Constant	-3.77158	3.045	-1.24	0.2248
Trend	0.0119325	0.1296	0.0921	0.9272
$\hat{\sigma} = 4,28116$		T=34	R <sup>2</sup> =0.9307	F[2,31] = 208,3 [0,000]**
$\chi^2_{\text{norm}}[2] = 0.15812 [0.9240]$		$F_{\text{het}}[4,29] = 2.3876 [0.0740]$		
$F_{\text{ar}(1-2)}[2,29] = 4.1973 [0.0251]^*$		$F_{\text{hetx}}[5,28] = 2.0669 [0.0997]$		
$F_{\text{arch}(1)}[1,32] = 0.073794 [0.7876]$				

<sup>a)</sup> Estimation period is 1977-2011.

The output from regression model for debt shows that lagged debt-to-GDP has a coefficient of 1,1, with a standard error of 0,09. The economic implication of this is that there exists a more than one-to-one relationship between lagged debt and current debt, so debt is growing at a rate higher than 1, i.e. exponential. A one unit increase in the debt-to-GDP ratio in the previous period results in a 1,1 unit increase in debt in the current period. The t-statistic of 11,7, has a p-value of 0,0000 and the variable is considered significant. The trend is not significant, with a reported t-statistic 0,09, and a p-value equal to 0,92 and not significant at even a 90% level.

From the reported  $R^2$  value the regression model explains 93,07% of the variation in debt-to-GDP, adjusted for the degrees of freedom. The following F-test-statistic of a joint null-hypothesis of all regressors being equal to zero is 208,3, which has a p-value equal to 0,000, so it can be rejected at the 99% level. The reported misspecification test has a rejection of the null-hypothesis at the 99% significance level for both auto-regressive error-terms and the regression specification test. The auto-correlated error terms may create a biased variance, and the standard errors reported may be incorrect.

Testing the null of a unit root in debt-to-GDP becomes equation (61).

$$(61) \quad \tau_t = \frac{1,10723 - 1}{0,09452} = 1,1344$$

The critical value for the DF-test with trend and constant is according to Mackinnon (1991)

$$(62) \quad DF_{(t,1,34)} = -3,4126 + \frac{-4,039}{34} + \frac{-17,83}{34^2} = -3,54$$

We cannot reject the null hypothesis of  $\rho=1$ , and conclude that debt-to-GDP has a unit root.

The results from including a higher degree of augmentation both for the model with constant and trend, and just a constant are reported in Table 5.

Table 5: ADF test for debt-to-GDP

D-lag	$\tau_t$ -ADF <sup>a</sup>	$\tau_c$ -ADF <sup>b</sup>
2	-0.3386	1.129
1	0.4000	1.535
0	1.472	2.582

<sup>a</sup> Test-statistic for constant and trend with critical values: 5% = -3.56 1% = -4.27. T=32.

<sup>b</sup> Test-statistic for constant with critical values: 5% = -2.96 1% = -3.65. T=32.

The reported critical value for the 99% confidence level is -4,27 for when the trend is included in addition to the constant, and -3,64 when only the constant is included. The reported test-statistics are above the critical values for all augmentations. This confirms the conclusion from the model without augmentation, that debt-to-GDP is non-stationary.

The economic implication of this is that debt is characterised as a “random-walk” and the current debt level is to a large extent based on the previous period’s debt level. Since  $\rho$  is larger than unity the debt-to-GDP continue to grow past the previous period’s debt-to-GDP level.

Bohn (1998, p. 296) argues that the unit root in debt or surplus to GDP exist due to a unit root in GDP.

## 4.5 Econometric testing for sustainability

To test for fiscal sustainability and the existence of a fiscal rule in the Portuguese economy I will formulate a basic fiscal feed-back rule based on Claeys (2008). Claeys did not find significant coefficients when he estimated his fiscal rule, and extended in to a Markow-Switching process to look for regime changes. I will, however, not look for regime changes, but try to specify a model that test sustainability, and gives significant results. In order to get a correct specified model I will extend Claeys basic rule with dummy variables to control for regime shifts, or more temporary but large expectation changes, due to exogenous economic or political events that have an impact on the Portuguese economy, and I regard the long-term fiscal indicator as a constant.

The motivation for including the dummy variables is that economic theory often assumes strong *ceteris paribus* conditions, but real world data are not created in a controlled environment but are the result of a highly complex process that involves both market behaviour and political decisions. Assigning dummy variables to the statistical model will bridge the gap between theory and the estimated results. (Spanos, 1995).

The regression model is given as

$$(63) \quad s_t = \alpha_0 + \rho s_{t-1} + \theta b_t + \gamma x_t + \beta_1 IMF2 + \beta_2 ERM + \beta_3 FC + \beta_4 OIL3 + \beta_5 priv + \varepsilon_t$$

The five dummy variables are:

*IMF2*: which is 1 for 1983 and 1984, and 0 otherwise, to represent the impact the 2<sup>nd</sup> round of IMF intervention in the Portuguese economy.

*OIL3*: which is 1 for 1986 and 1987, and 0 otherwise, to represent the impact of the 3rd oil shock when oil prices fell by 60%.

*PRIV*: which is 1 for 1989 and 1990, and 0 otherwise, to represent the impact of the privatisation reform.

*ERM*: which is 1 for 1992, 1993, 1994, 1995, 1996 and 1997, and 0 otherwise, to represent the stabilising effect the exchange rate mechanism had on Portuguese public finances in the period before qualifying for the Euro-zone.

*FC*: which is 1 for 2009, and 0 otherwise, to represent the impact of the financial crises on the Portuguese economy.

The dummy variables describe a change in the surplus-to-GDP ratio that is not due to changes in debt or automatic stabilisers/cyclical events. After the results of regression model I will estimate the baseline model, and show that the exclusion of the dummy variables destroys inference.

The results from OLS estimation on regression model (63) are reported in Table 6:

Table 6: Regression results from the fiscal feedback rule.<sup>a)</sup>

	Coefficient	S.E	t-statistic	P- value
$s_{t-1}$	0.325777	0.09701	3.36	0.0025
Constant	-5.39933	0.8806	-6.13	0.0000
$b_t$	0.0713490	0.01529	4.67	0.0001
$x_t$	0.327161	0.09673	3.38	0.0024
IMF2	2.99965	0.8765	3.42	0.0021
ERM	2.14966	0.6311	3.41	0.0022
FC	-6.77366	0.9957	-6.80	0.0000
OIL3	3.56696	0.7891	4.52	0.0001
PRIV	2.25885	0.9810	2.30	0.0299
$\hat{\sigma} = 1,13741$ $T = 34$ $R^2=0,85$ $\text{adj } R^2 = 0,806$ $F[8,25]=18,17[0,000]**$				
$\chi^2_{\text{norm}}[2] = 2,6449 [0,2665]$		$F_{\text{het}}[11,22] = 1.0163 [0.4645]$		
$F_{\text{ar}(1-2)}[2,23] = 2.9419 [0.0728]$		$F_{\text{hetx}}[14,19] = 0.76057 [0.6954]$		
$F_{\text{arch}(1)}[1,32] = 0.16949 [0.6833]$				

<sup>a)</sup> Estimation period is 1977-2011.

The results from regression model 0 are promising. The misspecification tests are not significant, so the regression model fulfils the classical assumptions for the error-term, and the specification of the model is correct. This implies that the different variances are estimated correctly and test-statistics will be correct.

The reported standard error of the model is 1,137. And the reported adjusted  $R^2$  is 0,806. This implies that 80,6% of the observed variation in surplus-to-GDP is explained by the model, adjusted for the degrees of freedom. The regression model overall is significant, with a reported F-value of 18,17, with a p-value at 0,000 it is possible to reject the null hypothesis at a 99% significance level.

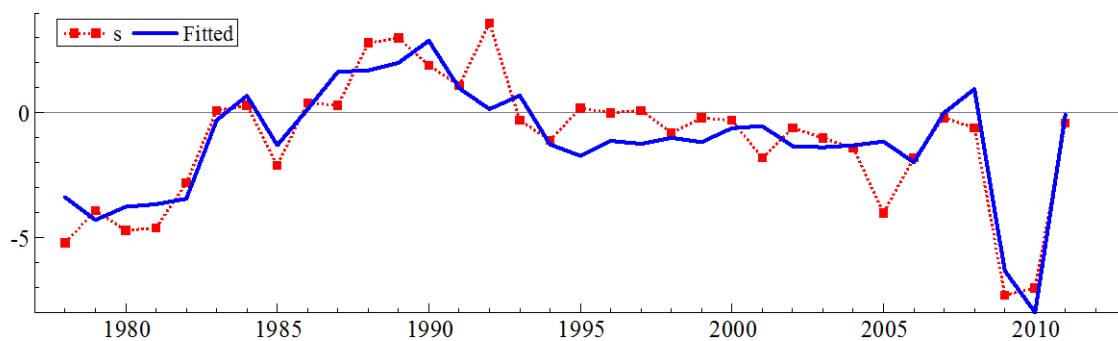


Figure 7: Observed surplus-to-GDP (broken line) versus the fitted values from the estimated regression model (solid line).

Figure 7 shows how well the model fits the data, where  $s$  is the observed surplus, and fitted is the regression model.

The estimated coefficients report the different explanatory variables' contribution to variation in the surplus-to-GDP ratio at time  $t$ . The estimated coefficient for the lagged surplus-to-GDP value,  $s_{t-1}$ , has a reported coefficient value of 0,325 with a standard error of 0,097. The reported t-statistic is 3,36, and from the reported p-value of 0,0025 we can reject the null-hypothesis that  $\rho=0$  and conclude that  $s_{t-1}$  is a significant explanatory variable when estimating  $s_t$  at a 95% level of significance. The economic implication of a positive coefficient for the lagged surplus-to-GDP variable is that running a surplus in the past period contributes to running a surplus in the present period. Increasing the surplus-to-GDP by one unit in the past period will increase surplus-to-GDP in present period with 0,325.

The estimated coefficient for the constant term is according to its p-value statistically different from zero. The economic interpretation of this is a “non-zero” surplus that will cause trend growth in debt. (Afonso, et al., 2011).

The reported estimated coefficient for the debt-to-GDP ratio is 0,071, with a standard error of 0,015. The reported t-statistic is 4,67, with a p-value of 0,0001 which we can reject the null hypothesis of  $\theta=0$  and conclude that debt-to-GDP significantly different from zero and explains variation in surplus-to-GDP. The economic implication of a positive response in surplus from an increase in debt is that fiscal policy is on a sustainable path, and tries to correct for an increase in debt. The null-hypothesis of passive fiscal policy,  $\theta=1$ , is rejected at the 99% level with a t-test and the conclusion of active fiscal policy can be drawn.

When there is a positive output gap, i.e. output above normal or potential, there is a positive response in surplus-to-GDP. A 1 unit increase in the output-gap make the surplus-to-GDP ratio increases 0,327, with a standard error of 0,096. The reported p-value confirms that the output-gap is a significant explanatory variable. The surplus-to-GDP ratio can be interpreted as “weakly pro-cyclical”. The cyclical elasticity of the budget in Portugal is about 0,46, and if the reported value is smaller than this coefficient, the budget is regarded as pro-cyclical, larger than 0,46 as “counter-cyclical” and not statistically different from 0,46 automatic stabilisers are let to work. A statistically insignificant coefficient implies a-cyclical fiscal policy. (Afonso, et al., 2011). Performing a hypothesis test, where the null-hypothesis is  $\gamma=0,46$  and the alternative is  $\gamma<0,46$ , will not lead to a rejection at the 95% level, but at the

90% level of significance. This implies that fiscal policy represented by the budget surplus-to-GDP ratios is weakly pro-cyclical.

The 2<sup>nd</sup> IMF “cure” in 1983-84 had a positive contribution to the surplus-to-GDP ratio with an estimated coefficient of 2,999 and a standard error of 0,876. The reported p-value confirms that variable is significant and the null-hypothesis of  $\beta_1=0$  can be rejected.

The exchange rate mechanism was in place from 1992 to 1997 and led to the qualification to join the Euro-zone. The estimated coefficient is 2,149 with a standard error of 0,631. The reported t-statistic, 3,41, with p-value 0,002 let ERM to be considered a significant variable. The ERM was a period of continuous devaluation and decreasing inflation, debt-to-GDP and surplus-to-GDP stabilisation in order to meet the Maastricht criteria. Portugal managed to meet the criteria as can be seen from the positive and significant coefficient for that period.

The global financial crisis that hit Europe with full force in 2009 had a negative impact on the surplus-to-GDP ratio. The estimated coefficient for the financial crises, FC, is -6,773 with a reported standard error of 0,995. The reported p-value is 0,000 and the null-hypothesis is reject, and FC is statistically different from zero. Due to the rejection of the null-hypothesis at the 95% significance level the financial crisis is considered significant explanatory variable. The high impact coefficient is due to the counter-cyclical discretionary measures that were conducted in order to minimise the impact from the global financial crisis. A more thorough description of the financial crisis’ impact on the Portuguese economy is provided in section 2.4.

The 3<sup>rd</sup> oil shock has an estimated coefficient of 3,566 with a reported standard error of 0,789. The reported p-value makes it possible to conclude that the 3<sup>rd</sup> oil shock has a coefficient that is statistically different from zero, and is significant as an explanatory variable at the 95% confidence level. When oil prices fell by 60 % in 1986 it was acknowledged as the 3<sup>rd</sup> oil shock. Portugal is dependent on imported energy, and when most companies are state-owned this type of shock will have a positive impact on the surplus-to-GDP ratio because the production costs of enterprises will fall. For oil exporting countries, like the US, UK and Norway this was the start of a recession and mass unemployment.

In 1989-90 Portugal reformed its constitution and one of the consequences was a wave of privatisation of enterprises. The revenue from these sales, and the fact that these enterprises



would no longer be listed in the public budget, contributed to an increased surplus-to-GDP ratio. This is illustrated by the positive estimated coefficient  $\beta_5$  at 2,258 with a reported standard error of 0,981. The reported p-value makes it possible to reject the null-hypothesis and conclude that the privatisation reform in 1989-90 had an impact on the surplus-to-GDP ratio.

Recursive graphics is a way of illustrating the stability of the different estimated parameters (Hendry & Nielsen, 2007). Recursive graphics for the estimated coefficients in regression model (63) is illustrated in Figure 8. The fifteen first observations have been used for initialisation and the series reported here is from 1992 until 2011. Panel a) shows the estimated coefficient for lagged surplus-to-GDP within a band of two standard errors (broken lines), and has been fairly stable, but with an increase in 2004. The intercept (panel b)) and the coefficient for debt (panel c)) are statistically significant for all the sample lengths covered by the table, and they both change in the mid-2000s. This suggests that the last few observations carry a lot of weight for separating the constant terms from the debt variable. Panel d) shows the estimated coefficient for the output gap,  $\gamma$ , which is reduced gradually, but which is still marginally significantly different from zero for the full sample, and with a sizeable point estimate of 0.3.

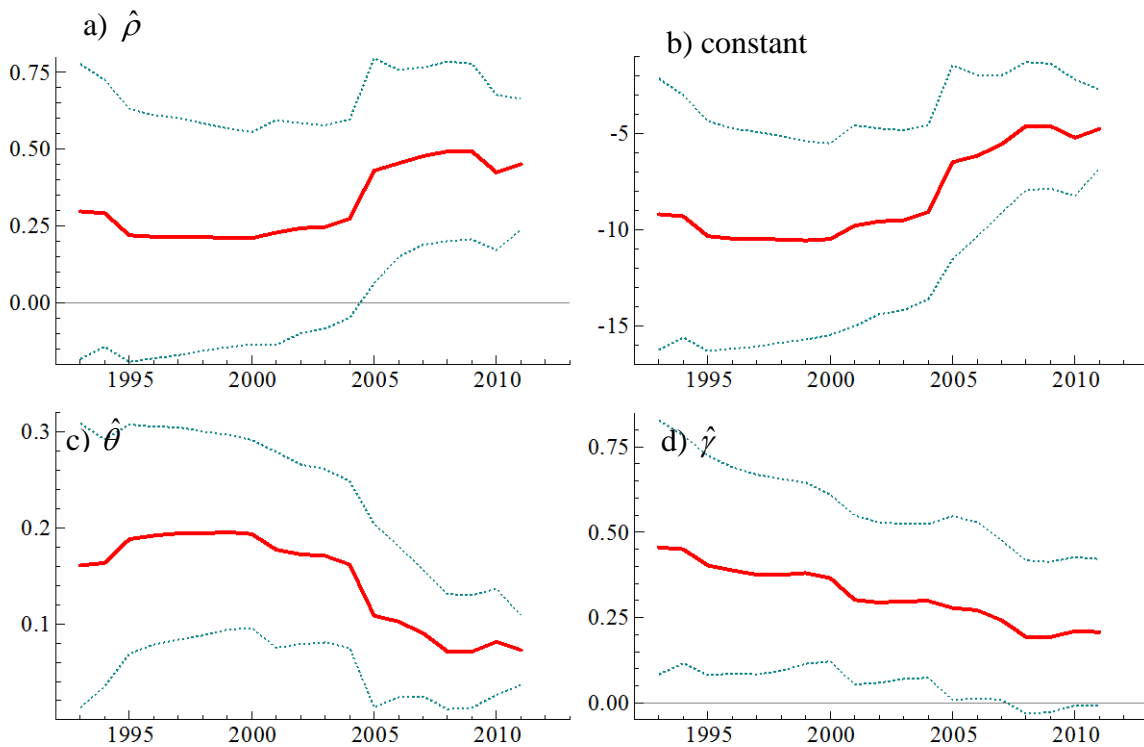


Figure 8: Recursive graphics of the estimated coefficients.

I will also estimate the baseline regression model from Claeys (2008):

$$(64) \quad s_t = \rho s_{t-1} + \alpha + \theta b_t + \gamma x_t + \varepsilon_t$$

The regression results from estimating (64) by OLS are reported in Table 7:

Table 7: Regression results from baseline fiscal feedback rule<sup>a)</sup>

	Coefficient	S.E	t-statistic	P-value
s <sub>t-1</sub>	0.616214	0.1507	4.09	0.0003
Constant	-1.16846	1.413	-0.827	0.4149
b <sub>t</sub>	0.0132449	0.02490	0.532	0.5987
x <sub>t</sub>	0.0867007	0.1530	0.567	0.5752
$\hat{\sigma} = 2,1661 \quad T=34 \quad R^2 = 0,3611 \quad \text{adj } R^2 = 0,297 \quad F[3,30]=5,654 \quad [0,003]**$				
$\chi^2_{\text{norm}}[2] = 6.7120 \quad [0.0349]^*$		$F_{\text{het}}[6,27] = 2.7086 \quad [0.0344]^*$		
$F_{\text{ar}(1-2)}[2,28] = 0.92859 \quad [0.4069]$		$F_{\text{hetx}}[9,24] = 3.8032 \quad [0.0042]**$		
$F_{\text{arch}(1)}[1,32] = 0.022605 \quad [0.8814]$				

<sup>a)</sup> Estimation period is 1977-2011.

Regression model (64) explains 36,11% of the variation in surplus-to-GDP, and a reported standard error of the regression of 2,166. The joint null hypothesis of the F-test is rejected at both the 95 and 99% level of significance.

The misspecification tests regarding normality and heteroskedasticity are significant at the 99% level, and the reported test-statistics may therefore be biased.

Overall, regression model 0 is superior to (64), which can be considered to have an omitted variable bias.

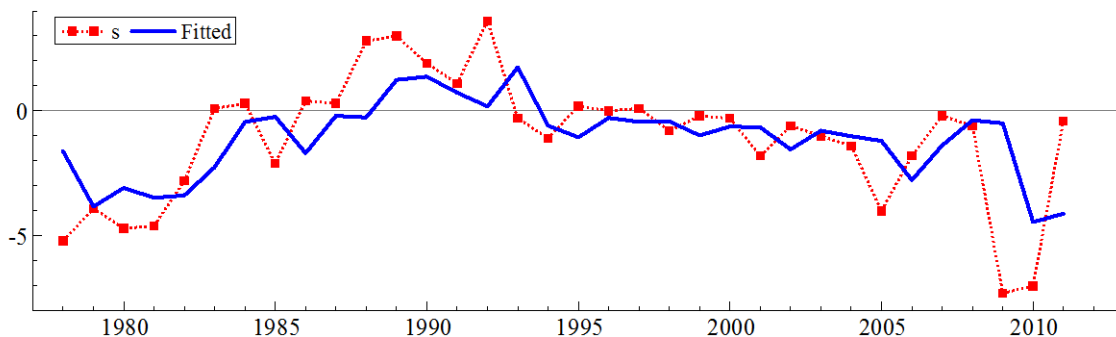


Figure 9: Observed surplus-to-GDP (broken) versus the fitted values (solid) from the estimated baseline regression model.

## 4.6 Testing for absence of cointegration

On the basis of the unit-root tests for the annual dataset I chose the surplus-to-GDP ratio and the debt-to-GDP as non-stationary variables. So far I have assumed that including the dummy variables is OK due to the fact that none of the misspecification tests for regression model 0 were significant. As already noted, non-stationary variables raise the issue of a spurious regression as well as its opposite, namely that the two variables are cointegrated. In order to confirm that the results I obtained from regression model 0 are correct, I will perform a cointegration test on the model.

In order to test for cointegration in regression model (63) I formulate the model as an error-correction model, henceforth ECM.

$$(65) \quad s_t = \lambda \bar{z}_t + \rho s_{t-1} + \theta b_t + \varepsilon_t,$$

where  $\bar{z}_t$  is a vector of stationary stochastic variables (the deterministic variables (dummies) have been omitted in order to simplify the notation.) I then add and subtract  $s_{t-1}$ :

$$(66) \quad s_t - s_{t-1} = \lambda \bar{z}_t + \rho s_{t-1} - s_{t-1} + \theta b_t + \varepsilon_t$$

$$(67) \quad \Delta s_t = \lambda \bar{z}_t + (\rho - 1)s_{t-1} + \theta b_t + \varepsilon_t$$

(67) is the ECM form of regression model 0. After the reparametrisation the standard errors and misspecification tests remain the same (Hendry & Nielsen, 2007, p. 244).

Under the null-hypothesis of no cointegration there is no error-correction in model (67), i.e.  $(\rho - 1) = 0$ . Under the alternative hypothesis of cointegration there is error-correction in the model, i.e.  $(\rho - 1) \neq 0$ . If the model has error-correction there exists a connection between surplus-to-GDP and debt-to-GDP, and the variables are cointegrated.

The test-statistic for testing the null hypothesis of no cointegration becomes:

$$(68) \quad \tau_c = \frac{(\hat{\rho} - 1)}{se(\hat{\rho} - 1)} = \frac{0,32577 - 1}{0,09701} = -6,95$$

which is compared to (simulated) critical values from a “Dickey-Fuller type” distribution. The critical values of the ECM cointegration tests depend on the number of I(1) explanatory

variables that are included in level form in the ECM model. In my case there is only one I(1) explanatory variable and the number of observations here is 34. With reference to Mackinnon (1991, p. 275, table 1) the 5% critical DF value is

$$(69) \quad DF_{(C,1,34)} = -2,8321 + \frac{-2,738}{34} + \frac{-8,36}{34^2} = -2,94 .$$

Since the test-statistic is below the critical value for the Dickey-Fuller distribution we can reject the null hypothesis of spurious regression and we conclude that the ECM regression 0 is balanced with cointegrated variables. For the estimated regression model 0 this means that the reported results are correct.

The economic implication of cointegration is that undiscounted public debt is finite in the long run, according to Claeys (2008, p. 13).

This is only a formal result however, since the true critical values of the ECM cointegration test are known to depend not only on the number of included I(1) variables, but also on the included I(0) variables and the deterministic dummy variable for regime shifts. There is no readily available tabulation of the relevant “true” critical values for our case. In order to take leverage due to the inclusion of the stationary output-gap variable, one possibility is to regard it, for the purpose of inference, as an I(1) variable. Hence, we calculate the critical values for two non-stationary series,  $DF(C,2,34)$ , which becomes

$$(70) \quad DF_{(C,2,34)} = -3,3377 + \frac{-5,967}{34} + \frac{-8,98}{34^2} = -3,52 .$$

The issue of the dummy variables is different and what matters for unit-root inference is whether they accumulate to a trend under the null of no cointegration. If they do accumulate to a trend, their critical values are affected, but if they do not, they can be thought of as (zero) residuals and the only modification needed is to reduce the number of observations. In our case, the dummies are single instance zero-one variables so under the null of no cointegration there is virtually no trend. In sum therefore, a robust test of cointegration can be based on  $DF(C,2,29)$  where the number of observations are corrected for number of dummy variables.

$$(71) \quad DF_{(C,2,29)} = -3,3377 + \frac{-5,967}{29} + \frac{-8,98}{29^2} = -3,554 .$$

Hendry and Nielsen (2007, p. 251) argue that the dummy variables may accumulate to a trend. If the dummy variables accumulate to a trend as argued by Hendry and Nielsen (2007, p. 251) the suggested approach is to subtract the dummy variable's mean values. The result is that the dummies will be approximately constant, rather than trending.

I formulate a regression model in order to counteract the cumulated trend in dummy variables:

$$(72) \quad s_t = \rho s_{t-1} + \alpha + \theta b_t + \gamma x_t + \beta_1 (IMF2 - \overline{IMF2}) + \beta_2 (ERM - \overline{ERM}) + \beta_3 (FC - \overline{FC}) + \beta_4 (OIL3 - \overline{OIL3}) + \beta_5 (PRIV - \overline{PRIV})$$

where the upper bar represents mean. The results from regression model (72) are reported in Table 8.

Table 8: Regression results from “de-meanned” regime dummy variables<sup>a)</sup>

	Coefficient	S.E	t-value	P-value
$s_{t-1}$	0.325777	0.09701	3.36	0.0025
Constant	-5.01124	0.8686	-5.77	0.0000
$b_t$	0.0713490	0.01529	4.67	0.0001
$x_t$	0.327161	0.09673	3.38	0.0024
$IMF2 - \overline{IMF2}$	2.99965	0.8765	3.42	0.0021
$ERM - \overline{ERM}$	2.14966	0.6311	3.41	0.0022
$FC - \overline{FC}$	3.56696	0.7891	4.52	0.0001
$OIL3 - \overline{OIL3}$	2.25885	0.9810	2.30	0.0299
$PRIV - \overline{PRIV}$	-6.77366	0.9957	-6.80	0.0000
<hr/>				
$\hat{\sigma} = 1,3741$	$T = 34$	$R^2 = 0,853$	$\text{adj } R^2 = 0,8062$	$F[8,25] = 18,17 [0,000]^*$
$\chi^2_{\text{norm}}[2] = 2,6449 [0,2665]$		$F_{\text{het}}[11,22] = 1.0163 [0.4645]$		
$F_{\text{ar}(1-2)}[2,23] = 2.9419 [0.0728]$		$F_{\text{hetx}}[14,19] = 0.76057 [0.6954]$		
$F_{\text{arch}(1)}[1,32] = 0.16949 [0.6833]$				

<sup>a)</sup> Estimation period is 1977-2011.

The only thing affected by this process is the constant term. This confirms that the most appropriate critical values are from the DF distribution with a constant.

The conclusion is cointegration between debt-to-GDP and surplus-to-GDP, and the results derived in section 4.5 from regression model (63) are not spurious.

The main findings from regression model (63) are evidence of a weakly pro-cyclical fiscal policy in the Portuguese economy and existence of a positive debt response in the surplus-to-

GDP ratio. This is a small indicator of sustainable fiscal policy, i.e. that the surplus-to-GDP adjusts to the new debt level as in the theoretical model presented in section 3.2.1, and by Bohn (1998).

Is fiscal policy in Portugal sustainable? The regime changes in Portugal represented by dummy variables are a reason for concern. Can Portugal manage on their own? Three of the four “positive” regime changes are due to exogenous events.

IMF dictating monetary policy in 1983-1984 contributed to an increase in surplus-to-GDP. As explained in section 2.2 an “IMF-cure” consists of export stimulation through devaluation, lower wages, austerity, increased interest rates and stricter credit controls.

During the exchange rate mechanism it was Portugal’s policies that made them qualify for the Euro-zone. From Figure 3 and Figure 5 surplus-to-GDP and debt-to-GDP remained within the levels dictated by the Maastricht criteria until 2004, but after that they are far off. The experience with IMF and ERM shows that when the “stick-and-carrot” goes, or external oversight is relaxed, sound fiscal policy suffers.

Portugal formally joined the EU during the 3rd oil shock, with the European Single Act also coming into place in 1986, and in 1987 the EU doubled their structural funds, which boosted the Portuguese economy further.

The privatisation reform was Portuguese policy, but in light of fiscal sustainability it can be considered a “one-off-measure”. It generates revenue the year its enacted, but all future possible profit is forgone.

Claeys (2008, p. 20) stress that the magnitude of the estimated coefficient for debt is not that important. As long as the stabilising response comes about on average will it be a sufficient requirement for sustainability. The reported coefficient in the Portuguese fiscal data is close to zero, while still significantly different from zero. However, the response is less than proportional. In order to actually be able to reduce the debt-to-GDP ratio significantly the response should be at least proportional (Favero & Monacelli, 2005). The motivation behind this is that in order to have a stable debt-to-GDP ratio, the surplus-to-GDP will have to increase more than debt-to-GDP. If the increase in debt is motivated by investments this will, hopefully, boost the economy and the surplus will increase due to automatic fiscal stabilisers

(reduced unemployment benefits, etc.). But, as seen in Reinhart and Rogoff (2010), when debt-to-GDP reaches the 90% threshold, growth can be difficult to achieve.

The required debt response can be illustrated by the debt-stabilising surplus requirement derived from the flow budget constraint (Claeys, 2008, pp. 14-15).

$$(73) \quad b_t = \frac{(1+r_t)}{(1+g_t)} b_{t-1} - s_t.$$

In (73)  $r_t$  is the interest rate on government debt, and  $g_t$  is the growth rate of the economy (growth in GDP).  $s_t$  and  $b_t$  are still surplus-to-GDP and debt-to-GDP respectively. Debt stabilising is equivalent to keeping  $b_t = b_{t-1}$ , and the required debt-stabilising surplus becomes

$$(74) \quad \bar{s}_t = \frac{r_t - g_t}{1 + g_t} b_{t-1}.$$

The reported growth rate in GDP for the last for the quarter in 2011 is -1,32%. And the yield to maturity of a 10 year Portuguese government bond is 13,8% (ECB, 2012). Inserting the current values of the variables in (74) becomes

$$(75) \quad \bar{s}_t = \frac{0,138 - (-0,0132)}{1 + (-0,0132)} 107,8 = 16,5$$

Debt stabilisation requires a government surplus-to-GDP of 16,5%. So to be able to pay off debt Portugal needs to run a surplus larger than 16,5% of GDP.

The calculations above illustrate a strict requirement for debt-stabilisation. A requirement for a 16,5% surplus-to-GDP ratio is harsh, especially considering that the debt response is only 0,05, so the rest of the increase in surplus-to-GDP has to come from elsewhere.

Portugal is now on a path with negative growth in output, and from the debt-stabilising surplus the requirement to overcome the debt trap is even larger.

From the theoretical model in section 3.2.1, when the interest rate on debt exceeds the economic growth rate, it implies an unstable wealth-ratio and exploding debt levels. Explosive debt-to-GDP levels are consistent with Figure 3 from 2005 and onwards.

## 5 Conclusion

In this thesis I have presented a theoretical background and framework to analyse fiscal policy sustainability. I have analysed fiscal policy in Portugal from 1977 until 2011 in light of their economic history.

The results were promising in the sense that I still found a positive response in surplus-to-GDP that Afonso, et al. (2011) also found in their article using data until 2007. I also found evidence of a weakly pro-cyclical fiscal policy.

However, the response is far from proportional, and not consistent with passive fiscal policy. The requirement for debt-stabilisation that I found, a surplus-to-GDP of 16,5% is, without sounding unreasonable, impossible to achieve, at least when taking into account negative growth in GDP.

Interest rates have declined in 2012 due to Mario Draghi's promises to "do whatever it takes to save the Euro-zone". There still is a long way to go before the growth rate in GDP exceeds real interest rates, which is the theoretical approach to avoid exploding debt. Also, trying to stabilise debt at the current levels of interest and growth will require a level of austerity not consistent with economic growth.

To conclude, Portugal is the "living evidence" of how debt levels explode when interest rates exceeds the growth rate of the economy. However, the positive response in fiscal policy to increasing debt levels may be evidence of effects from the last EDP, and hope that the positive effects on the economy will last even when the external oversight is gone.



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